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SHIP STRUCTURAL CASUALTY DATA ASSESSMENT.(U)

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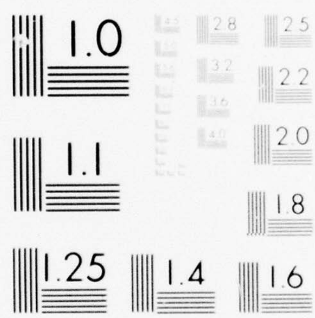

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PROJECT SR-247

SHIP STRUCTURAL CASUALTY DATA ASSESSMENT

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SHIP STRUCTURE COMMITTEE
1977

TECHNICAL REPORT

on

Project SR-247,

"Critical Analysis of Ship Structural Casualty Data"

SHIP STRUCTURAL CASUALTY DATA ASSESSMENT

by

John C. Daidola
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Robert Stanley

M. ROSENBLATT & SON, INC.

under

Department of the Navy
Naval Ship Engineering Center
Contract No. 4255
Task No. 6120-690

~~N00076-C-04255~~
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U. S. Coast Guard Headquarters
Washington, D.C.
1977

(See 1473)

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1. INTRODUCTION

The considerations necessary to assure merchant marine shipping will be a profit making endeavor are many. One in particular is that of keeping structural casualties from occurring. The results will be reduced operating costs (repairs and insurance premiums) and vessel down-time.

In order to reduce the number of structural casualties, those that have occurred should be analyzed to determine the reason and remedy. More specifically, the analysis of structural casualties can provide data for at least five important areas: first, the input to a general reliability analysis of the ship as a system including both structural and non-structural sub-systems; second, indications with regard to structural modifications needed on existing vessels; third, indications with regard to new structural schemes that should be considered in future designs; fourth, indications with regard to new research which is needed to analyze and improve conditions; fifth and last, indications with regard to non-structural aspects of the ship or aspects of its environment that need improving. Each of these specific areas, of course, relate to increasing the reliability of the ship.

This project is concerned with these various aspects of structural casualties and their influences on the reliability of the ship. The primary reason for the investigation has been the desire of the Ship Structure Committee to develop a procedure, or use an existing one, using structural casualty data, to assign priorities to future research projects on a cost effective basis. The availability of adequate data for such a study had been questioned and hence this pilot study to evaluate the situation developed.

The following is a complete list of the tasks that are considered herein:

a. Extensive search of merchant ship damage records to ascertain what records are available for future studies and where they may be obtained.

b. An assessment of the records identified in a. with respect to their potential value for an analysis of ship structural casualties.

c. Recommendation of procedures to maintain and analyze data on all types and sources of ship damage for incorporating into reliability design.

d. Means to compile data necessary to analyze structural response and damage caused by collision, stranding, and other events.

e. Recommend a format for use of data in d. in reliability design.

f. Recommendation of procedures to maintain and analyze data for establishing research and design priorities.

The work performed to comply with the various tasks is presented in the sections that follow. The purpose of Section 2 is to describe the ship structural casualties that are to be addressed. Section 3 describes a format for reliability based design (task e. above). Section 4 discusses the types of structural analyses and their required input, that are needed to evaluate structural casualties. Section 5 describes what is necessary for analyzing structural casualty data to establish priorities for research and design projects (task f.above). Section 6 discusses the type of data which must be collected to provide adequate information for researchers and designers to evaluate structural casualties (task d. above).

Section 7 presents samples of available damage records and evaluations of their potential value for use in the studies considered in this project (tasks a. and b. above). Section 8 discusses available methods of analyzing data for use in the studies considered in this project (task c. above). Section 9 discusses possible future methods of collecting and analyzing data (task c. above). Section 10 presents the conclusions and Section 11 the recommendations for future work.

2. DESCRIPTION OF SHIP STRUCTURAL CASUALTIES

2.1 Introduction

Ships are involved in many types of structural casualties. The following list has been identified and discussed in this report:

- Collisions with Piers, Quays
- Collisions with Vessels Alongside
- Collisions with Locks
- Collisions with Vessels Underway
- Miscellaneous Collisions
- Seaway Damage, Bottom Slamming
- Seaway Damage, Bow
- Seaway Damage, Forecastle and Weather Deck
- Seaway Damage, Springing
- Seaway Damage, Miscellaneous
- Grounding
- Struck Object in Water
- Structural Detail Inadequacy
- Hull Flexibility - Fatigue
- Hull Flexibility - Deflection
- Vibration - Propeller Induced
- Explosion
- Ice
- Wastage
- Fire
- Loading or Discharging Cargo
- Launching or Dry Docking

Table 2-1 reproduced from Reference (1)*, gives an indication of the frequency-of-occurrence of some of the above listed structural casualties. The data for Table 2-1 represents 824 structural damage cases from 146 ships. It should be noted that frequency-of-occurrence is not necessarily the true measure of the severity of damage. Injury to or loss of life and cost are the best measures. Only the latter is considered herein.

Below, a description of the structural damages and effects associated with each of the structural casualties listed above, is given. The purpose is to identify exactly what structural phenomena are present in each case, since it is these which must be analyzed whether the purpose is to assign research project priorities, develop analysis techniques or improve a design.

2.2 Collisions

- Localized damages
- Plastic plate deformation
- Plastic bending of stiffeners, girders and webs
- Tripping of stiffeners and girders
- Plate folding
- Plate membrane stretching
- Web and girder shearing
- Buckling of tripping brackets and horizontal struts
- Propagation of yielded zones in plates
- Fracture

*Numbers in parentheses indicate references in the reference section.

TABLE 2-1 STRUCTURAL CASUALTY DATA BASE

ALLEGED CAUSE	NUMBER OF CASES	PERCENT OF TOTAL
Collisions with Piers, Quays	203	24.6
Collision with Vessels Alongside	179	21.7
Collisions with Locks	75	9.1
Collisions with Vessels Underway	66	8.0
Miscellaneous Collisions	27	3.3
Heavy Weather, Bottom Slamming	48	5.8
Heavy Weather, Forecastle and Weather Deck	23	2.8
Heavy Weather, Miscellaneous	17	2.1
Grounding	37	4.5
Struck Object in Water	14	1.7
Ice	7	1.0
Wastage	8	1.0
Fire	4	1.0
Launching or Dry Docking	2	1.0
Loading or Discharging Cargo	18	2.2
Miscellaneous	10	1.2
Undetermined	86	10.4
	824	100.0

2.3 Seaway Damage

- Same as collision damage in general
- Fatigue of main hull girder longitudinal structure

2.4 Grounding

- Same as collision damage in general
- Bending of main hull girder (pinnacle bending)

2.5 Struck Object in Water

- Same as collision and grounding damage in general

2.6 Structural Detail Inadequacy

- Fatigue of local structure
- Fracture in plating, girders, webs
- Plate buckling in all types of webs
- Corrosion
- Brittle fracture
- Welding associated failure

2.7 Hull Flexibility

- Fatigue of main hull girder structure
- Undesirable deflections with respect to shafting and piping systems

2.8 Vibration - Propeller Induced

- Fatigue of local structure
- Undesirable motion response for crew and sensitive machinery

2.9 Explosion

- Similar to collisions

2.10 Ice

- Similar to collisions

2.11 Wastage

- Chemical Corrosion
- Electrochemical Corrosion
- Stress Corrosion
- Impingement Attack
- Cavitation Damage
- Hydrogen Embrittlement

2.12 <u>Fire</u>

- Heat Damage

2.13 <u>Loading or Discharging of Cargo</u>

- Similar to collisions

2.14 <u>Launching or Dry Docking</u>

- Similar to collisions and grounding

3. RELIABILITY DESIGN

3.1 Introduction

The purpose of this section is to indicate a format for a formal reliability analysis of the ship from the standpoint of its capability to perform its mission at minimum repair costs. The damages considered are structural casualties. The output will be the reliability of the ship in performing its mission and the sensitivity of this capability to individual influences which may be both structural and non-structural.

The reliability of the hull girder in resisting the loadings imposed on it by the seaway is currently under investigation. This type of analysis is concerned with safety of the main hull girder structural design. The output will be factors of safety that should be applied by designers to the structural design of the main hull girder.

The two analyses described above differ somewhat in that the former identifies problem areas in the ship that are causing degraded performance, while the latter yields design criteria that should yield better reliability of a potential problem area. Obviously once a problem is identified by the mission capability analysis, the solution could involve a more specific reliability analysis of that area, as is presently being done for the main hull girder.

As defined herein; "Reliability is the probability that a system will perform satisfactorily for at least a given period of time when used under stated conditions (2)". During the last decade, reliability prediction techniques have been developed extensively in the electronics field and to a lesser extent in others.

This section presents some of the fundamental bases of reliability, as developed for electronics and flight vehicle propulsion systems. Possible applications to ship structural casualties are noted. One must bare in mind, of course, that reliability *is only one of the factors* which determine the overall worth of a system." The design of a system with the highest possible reliability would be expected to differ from that of a system with the least weight, the highest performance capability, the lowest cost, the highest maintainability, or the shortest development time (2)". Therefore trade-offs among these attributes must be made. These trade-offs require quantitative estimates of reliability.

Reliability predictions can be made at various stages of development (i.e. feasibility design, preliminary design, contract design, detail design). The step-by-step procedure for a final design reliability analysis is generally taken as follows:

1. Define the System
2. Define Failure
3. Define Operating and Maintenance Conditions
4. Construct Reliability Block Diagram(s)
5. Develop Reliability Formula
6. Compile Parts List
7. Assign Failure Rates or Probabilities of Survival
8. Compute System Reliability

Below, each of the above steps will be covered in some detail, with application to ship structural casualties noted.

3.2 Systems

The system is the collection of items to which the reliability analysis pertains, namely, the ship itself. "The task of defining the system, then, consists of explicitly describing the functions and physical boundaries of the items that constitute the system. Particular attention must be given to interfaces among systems so that all pertinent items will be considered in a prediction and there will be no unwanted duplication of coverage in predictions for adjacent systems (2)".

The primary subsystems are those major ship systems which affect or are effected by structural casualties. These are the navigation system, the main propulsion system, the maneuvering system, the structure, cargo handling machinery, and the deck equipment. Each primary subsystem then has secondary subsystems and so forth. Figure 3-1 depicts examples of these subsystems. Secondary and higher level subsystems are shown for navigation systems and structure only.

Figure 3-1 does not indicate the functional relationships between the subsystems. In reliability analyses, functional block diagrams and reliability block diagrams are required however. Reliability block diagrams, which will be described later, are developed through analyses of the functional relationships among items of equipment as shown by functional block diagrams. For ship structural casualties, these functional diagrams will have a different underlying

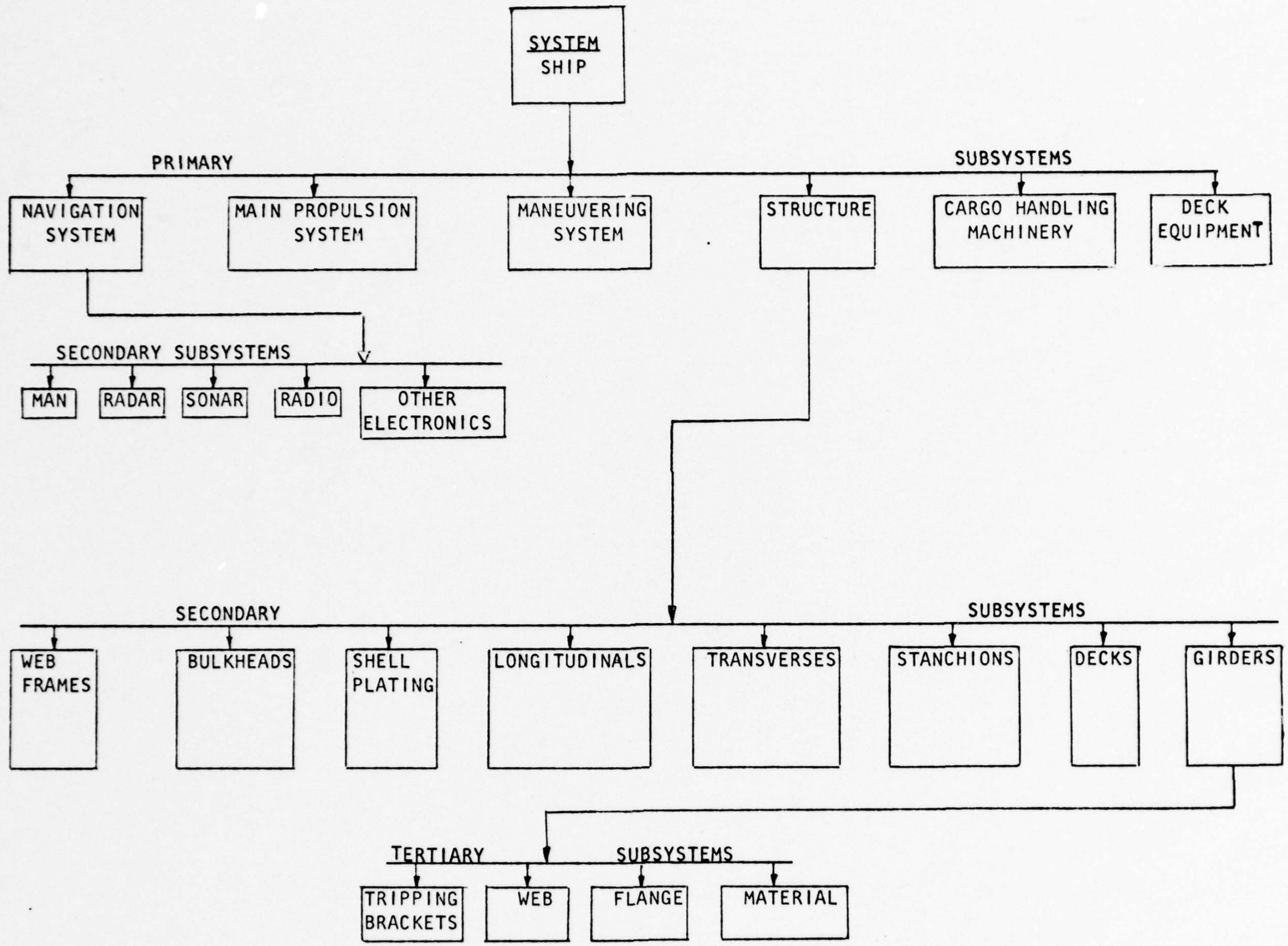


FIGURE 3-1: SHIP SYSTEM AND SUBSYSTEMS FOR STRUCTURAL CASUALTIES

nature than those for electronic systems, for instance. In the latter the functional diagrams are circuit schematics indicating direct physical contact between two subsystems. In the case of the ship navigation system affecting the structural damage, the connection is not physical but certainly significant. Since the intent of this project is not to develop detailed functional block diagrams, let it suffice to say that their development should be possible for ship structural casualty reliability analyses.

3.3 Failure

Generally failure is defined as the occurrence of any condition which renders the system incapable of operating within its specified performance parameter limits (2), however, any definition will do as long as it is explicitly given.

For ship structural casualties a logical choice of failure, based on previous analyses, is cost of repairs. The cost of repairs is usually known or can be estimated given a proper description of damage, lay-up time, etc.

3.4 Operating and Maintenance Conditions

3.4.1 Operating Conditions

Operating conditions include the system's operational profile and the environmental conditions prevailing during the various periods of operation. The operational program is defined in terms of the elapsed mission times during operation throughout each phase.

For the case of ship structural casualty damage the operational program may not necessarily be required. The reason is that ship damage data could be obtained for similar ships on similar trades and routes, which should automatically account for all expected environmental conditions.

3.4.2 Maintenance Conditions

The most significant maintenance condition that may affect reliability of ship structure would relate to which items could be repaired during the regularly scheduled drydockings.

3.5 Reliability Block Diagram (s)

A reliability block diagram may be considered a logic chart which, by means of the arrangement of blocks and lines, depicts the effect of failure of subsystems of the system on the system's functional capability. Subsystems whose failure causes system failure are shown in series with other items.

For a complex system such as in the case of a ship, several reliability block diagrams could be utilized. The first would be a simple diagram showing the primary subdivisions." This process of diagramming goes on until individual blocks represent complexity of such an order that their reliabilities can be readily estimated from part level data (2)".

For the present case of structural casualties the "part levels" would be, for example, the complete individual working pieces of navigation equipment, for the navigation subsystem; tripping brackets, webs, flanges, materials, etc. for the structural subsystem.

"On a two-dimensional diagram it is frequently not possible to convey all of the pertinent information merely by the arrangement of blocks and interconnecting lines. Therefore, appropriate notation should be included on the diagram or in accompanying verbal descriptions."

Section 3.6 presents an example of a reliability block diagram.

3.6 Reliability Formulas

The reliability formula expresses the relationship of system reliability to the reliabilities of the subsystems depicted as blocks on the reliability diagram.

Specifically it is a mathematical formula relating the probability of satisfactory performance to some variable. Although this variable is usually "time", for the case of structural casualties it might be the reciprocal of the "cost" of repairs. The reliability formula is related to the common distribution function of statistics as follows:

$R(t)$ = reliability function = $1-F(t)$

$F(t)$ = distribution function = $\int_0^t f(t)dt$

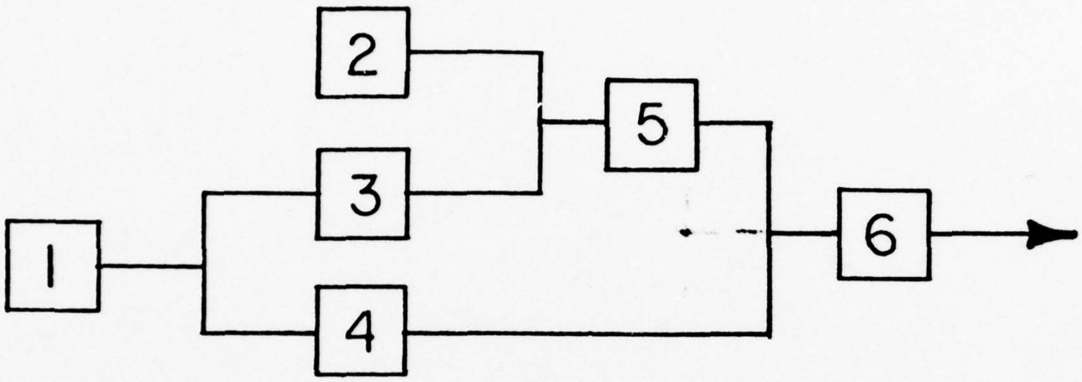
= probability that in a random trial, the random variable is not greater than t(i.e. unreliability function).

$f(t)$ = density function

t = parameter, say 1/x dollars repair cost in 20 years.

As an example of a system reliability function formula consider the following (2):

RELIABILITY BLOCK DIAGRAM



Where 1, 2, 3, 4, 5, 6 indicate subsystems. Assuming independence of subsystem failures, and using standard probability theory:

$$
\begin{aligned}
R(t) = R_6(t)\ [&R_1(t)R_4(t) + R_2(t)R_5(t) \\
&+R_1(t)R_3(t)R_5(t) + R_1(t)R_2(t)R_3(t)R_4(t)R_5(t) - R_1(t)R_2(t)R_3(t)R_5(t) \\
&-R_1(t)R_2(t)R_4(t)R_5(t) - R_1(t)R_3(t)R_4(t)R_5(t)]
\end{aligned}
$$

Where: $R(t)$ = system reliability function

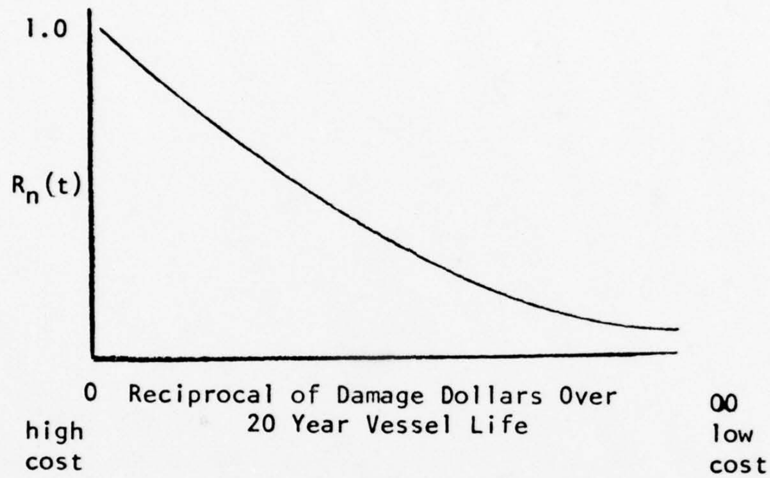
$R_n(t)$ = subsystem reliability functions

It is important to note that the above example reliability function formula holds regardless of the types of statistical distributions that represent each subsystem reliability function. However, it has been determined by experience that most failure patterns can be represented by a relatively small number of distribu-

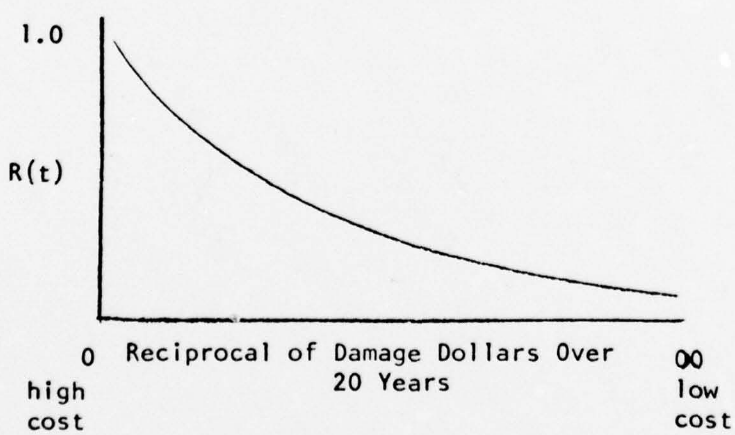
tion types. The types most commonly encountered are the normal or Gaussian, the exponential, and the more general Weibull (2).

In order to determine the subsystem distribution functions, samples could be made of the total population of the subsystem under consideration. Since it is seldom feasible to make measurements on entire populations, the use of statistical techniques is necessary. Since studies in other fields have indicated that reliability functions are most commonly of the normal or Gaussian, the exponential or the more general Weibull, if enough sample data exists to estimate the parameters of these distributions, using confidence interval testing, the proper distribution should be obtainable. These reliability functions would be theoretical.

Say for instance that a reliability function can be developed for each subsystem in the following form, (where $R_n(t)$ denotes the probability of survival of the subsystem given that specific "damage dollars" are available for repair):



With these various subsystem reliability functions the system reliability function, $R(t)$, can be evaluated:



Further, by varying each $R_n(t)$ a sensitivity study can be performed on $R(t)$, which should indicate which subsystem improvements will have the most beneficial effects on $R(t)$, system reliability.

3.7 Parts List

For a ship this would be a list of the finest subdivision of subsystems.

3.8 Assign Failure Rates or Probabilities of Survival to Individual Parts

These must be determined from the casualty data and statistical analyses as mentioned in Section 3.6.

3.9 Compute System Reliability

As discussed in Section 3.6, by plugging the subsystem reliability functions into the system reliability function formula, the reliability of the system can be evaluated.

Also, as mentioned previously, by varying the subsystem reliability functions the sensitivity of the system reliability function to each can be evaluated.

4. STRUCTURAL ANALYSIS

4.1 Introduction

An analysis of structural deformation and failures in structural casualties will require proper analytical and experimental tools. By considering existing analytical techniques and experimental results, the type of data that is necessary for analysis of the structure using these tools will be clearly indicated. It is not meant that analytical techniques exist for every type of structural failure. In fact, the purpose of future research may be to develop such techniques. However, there are many that will give the analyzer at least a first-cut idea of the nature of a structural casualty.

If the purpose of an analysis is to determine the loading imposed on the vessel that caused the damage, with adequate analytical techniques and experimental results, in some cases, the load might be determined by working back from the noted deformation.

If the purpose of an analysis is to determine the structure required to prevent an identical structural casualty in the future, the estimated loads, analytical techniques, and experimental results can be used to design the new structure.

If the purpose of an analysis is to establish priorities for future research, then basic structural analyses techniques and experimental results may be necessary to determine what the problem may be.

The following is a list of structural deformations and failures applicable to structural casualties:

1. Elastic deformation of beams and plates
2. Plastic deformation of beams and plates
3. Fatigue
4. Brittle fracture
5. Stress concentration
6. Buckling
7. Wastage
8. Welding flaws

For each of these types of failure, some type(s) of analytical techniques and experimental results exist that allow various degrees of quantification of the failure to be achieved. In the sections that follow, some of these techniques and results will be discussed briefly with major input and output noted, since these factors directly bear on the required collision data and its final value in the analysis of structural casualties.

4.2 Elastic Deformation of Beams and Plates

Many analytical techniques exist for the elastic analysis of structure of all types. The techniques range from simple formulas for individual beam and plate elements with simple loading, to large finite element computer programs for large composite indeterminate structures with arbitrary load.

The common inputs to such techniques are:

- Structural section properties
- Material properties
- Mass
- Detailed Geometry
- Load magnitude and distribution
- Geometry of the failure
- Damping

The common outputs of such techniques are:

- Stress
- Deformation
- Load

4.3 Plastic Deformation of Beams and Plates

The theories and analytical methods of plastic deformation are not as well developed as those for the elastic case. However, in general, the same input and output as given under Section 4.2 above applies.

It should be noted that more detailed material properties are required.

4.4 Fatigue

Fatigue is more or less analyzed by having knowledge of the magnitude and frequency of occurrence of a cyclic stress and comparing these to the stress cycle diagram of the structural material.

The methods mentioned in Section 4.2 can be used to evaluate the stress-frequency characteristics of the structure.

The stress-cycle diagrams for various materials are available in the literature. Also, stress-cycle diagrams for various typical detail sections of ship structure under different conditions (normal, flawed, corroded) have been presented (3,4 for instance).

The inputs to a fatigue analysis could then consist of the following:

- Elastic analysis of structure
- Stress-cycle characteristics of material and structure
- Presence of flaws in material or welds
- Presence of corrosion or other degradation
- Geometry of failure

The output should be the knowledge of which factor or factors caused the fatigue failure.

4.5 Brittle Fracture

Brittle fracture must be analyzed more qualitatively than quantitatively. The inputs to the analysis are:

- Material properties
- Ambient temperature
- Appearance of inordinately high local stress (resulting in high strain-rates)
- Appearance of possible biaxial and triaxial tensile stresses
- Presence of notches
- Geometry of failure

The output should be the knowledge of which factor or factors caused the brittle fracture.

4.6 Stress Concentration

The effects of stress concentration are usually quantified by applying a multiplicative factor (greater than 1.0), the stress concentration factor, to the nominal stress in the area of the stress concentration.

This factor has been determined for many different shapes of abrupt changes in cross section of structure.

The inputs to the analysis are:

- Nominal stress
- Geometry of affected structure and abrupt change in cross section
- Geometry of failure

4.7 Buckling

Buckling may be either elastic or inelastic. Simple formulas have been developed to analyze single plates and beams. Some finite element programs allow for buckling analyses of general structure.

Buckling may appear as an out of line column, plate folding, or tripped longitudinal members.

The inputs to buckling analyses are in general the same as for elastic and plastic deformation as described in Sections 4.2 and 4.3.

4.8 Wastage

Wastage is meant here to include all types of dissipation of structural material. This will include chemical and electrochemical corrosion, stress corrosion, impingement attack, cavitation damage and hydrogen embrittlement.

Various techniques exist which are applicable to the analyses of these phenomena. The analytical descriptions are far from being all inclusive, complete and design oriented. In design, generally, empirical "wastage allowances" or additions to structural scantlings above those dictated by nominal stress are used.

The following input will be needed to identify the type of wastage and to perform any analyses:

- Appearance
- Operational environment scenario
- Material properties
- Stress levels in affected structure
- Crevice and pit size
- Presence of aerated flaws about structure (impingement attack)
- Presence of cavitation

4.9 Welding Flaws

Using only vision to inspect a failed weld, one may be able to detect:

- Undersize weld
- Surface Porosity
- Internal porosity
- Undercut
- Cracks

- Lack of penetration
- Slag inclusions
- Incomplete fusion
- Incomplete root penetration
- Icicles or burnthrough

4.10 Conclusions

Sections 4.2 through 4.9 have indicated the type of data that are necessary to evaluate a casualty from a structural standpoint. This data is necessary for a structural analyst or researcher to identify the type of failure, evaluate the stress and redesign for non-failure. Therefore it must be available in casualty data.

5. DATA FOR ESTABLISHING RESEARCH PROJECT PRIORITIES

5.1 Introduction

With limited research funds available, candidate research programs must be initiated in a sequence according to the benefit that can ultimately be gained from them.

The purpose of this section is to describe the possibilities of using structural casualty data to establish priorities for research programs on a cost effectiveness basis.

5.2 Measure of Merit

The cost effectiveness can be measured in terms of the dollars that the structural problem is costing the maritime community. This cost should include that of repairing the ship, "off-charter" losses, and the cost of maintaining the vessel and crew while laid up.

5.3 Research Program

5.3.1 General

The research programs addressed herein are those that are concerned with structural aspects of ships. The Ship Structure Committee of the National Research Council does have such programs. An appreciation for the breadth of structural disciplines considered can be gained from Table 5-1, reproduced from Reference 5. Table 5-1 deals with at least the following topics:

- Structural casualties
- Hull girder loads
- Welding
- Lamellar tearing
- Fracture

TABLES 5-1 - SHIP STRUCTURE COMMITTEE RECOMMENDED PROJECTS FOR THE 1977 FISCAL YEAR

Priority	Project Title	Page
1	"Reduction of SL-7 Scratch-Gage Data"	16
2	"Updating of Fillet Weld Strength Parameters (Allowable Shear) and the Applicability of Updated Shear Strengths to Shipbuilding"	18
3	"Critical Analysis of Ship Structural Casualty Data"	20
4	"Underwater Nondestructive Inspection of Welds"	22
5	"Significance and Control of Lamellar Tearing of Steel Plate in the Shipbuilding Industry"	23
6	"Fracture Toughness Characterization of Electro Slag and Electrogas Weldments in Ship Steels"	31
7	"Fatigue Considerations in View of Measured Load Spectra"	35
8	"Surveillance and Coordination of Ship Collision/Stranding Research Studies"	37
9	"Pressure Distribution Model Tests in Waves"	39
10	"Prediction of Transverse Plane and Torsional Dynamic Loads"	41
11	"Nondestructive Inspection of Heavy Section Castings, Forgings and Weldments"	43
12	"Evaluation of Liquid Dynamic Loads in Slack Cargo Tanks"	45
13	"Computer Simulation of Hull Dynamic Response"	48
14	"Hull Structural Damping Data"	50
15	"Ultimate Strength of Midship Section"	52
16	"Internal Corrosion and Coating Application Study"	54
17	"Statistical Load History for Ice Breaking Vessels"	56
18	"Effect of Slamming and Whipping on Midship Bending Stresses"	58
19	"Design Method for End Sections of Ships"	60

- Fatigue
- Material Flaws
- Tank Loads
- Elastic - Plastic Analyses of Main Hull Girder
- Wastage

The various types of research may consider structural casualties from a macroscopic or microscopic viewpoint. In a macroscopic analysis, individual structural phenomena are not generally considered, but rather, the overall outcome of the failure is of importance. For instance, if it is desired to identify the frequency of occurrence of collisions and groundings, the only required data besides the vessel particulars is whether or not the collision or grounding occurred. On the other hand, if it is desired to identify the types of structural failures during a collision, a detailed description of the damage will be needed. The latter consideration is microscopic.

5.3.2 Microscopic Structural Phenomena

In the context of this study, microscopic structural phenomena are to mean specific types of structural failure and deformation. A sample list of such phenomena is given in Section 4.1.

In order to use structural casualty data to predict the cost effectiveness of research programs concerned with such phenomena, detailed data similar to that noted in Section 4 would have to be available.

5.3.3 Macroscopic Structural Phenomena

In some cases research may not be concerned with microscopic structural phenomena, but instead a general analysis of the nature and circumstances of the structural casualty. Data necessary to describe a casualty by such macroscopic phenomena could be much less detailed than that needed for microscopic phenomena.

As an example of macroscopic data, consider the damage survey analysis data (See Appendix A) of the U.S. Salvage Association:

- A vessel is divided into 100 parts, listed alphabetically, and termed affected elements.
- Vessels are divided into 17 types, with most of these types further subdivided into deadweight categories.
- The world is divided into 880 geographical areas.
- Casualty causes are comprised of 46 fortuitous events.
- The repair costs for the repair of the three most costly affected elements are gathered, as well as the total cost of repairs.
- The time to carry out repairs for each of the three most-costly-to-repair affected elements is recorded, as well as the total time for all repairs.
- The status of repairs is recorded, i.e. repairs carried out, deferred, partly carried out, etc.

5.4 Conclusions

Depending on the type of research to be considered, the data required for establishing priorities can be quite varied in detail.

In general, if microscopic structural phenomena or characteristics are to be considered the data must be of a form that can be used in analytical techniques and must provide enough description for the analyzer to distinguish the exact phenomena present. For macroscopic studies a more general description of the casualty should be adequate.

6. DATA FOR RESEARCH AND DESIGN

6.1 Introduction

The previous section has discussed the type of data that is needed to assign priorities to research projects. In addition, the data available to the researchers to aid them in developing new techniques and analyses must be considered, since without this data the projects may fall far short of being a success.

For example, in the course of performing the work on Minor Tanker Collisions (6), it was found that the structural casualty data available through the USCG, individual owners' files and U.S. Salvage, did not give sufficient detail of damage for determining all the structural modes of failure and for comparing theoretical structural deformations and failures to actual occurrences. There was enough information to indicate that tanker collisions were frequent and costly however. The result was that the USCG, MR&S, and USS were forced to conduct special damage surveys (7) expressly for the purpose of determining all the structural modes of failure present and for comparing theory to actuality. The surveys were extremely beneficial to the study.

Reference (8) mentions some important points with respect to the subject of failure data for design. The comments stated therein are particularly enlightening since the members of the committee making these comments represented designers, classification societies, shipbuilders, professors and others from the field. Figure 6-1 is a copy of a page from Reference 8. "Recommendations for Future Research" makes it obvious that the authors feel that a much more detailed description of the damage than is currently recorded is

Figure 6-1: From; "Fabrication Factors Affecting Structural Capability of Ships and Other Marine Structures," 6th International Ship Structures Congress, Report of Committee III.3, 1976.

but recently a considerable research is going on in cooperation between the main Swedish Yards and the government in order to establish a sound theoretical background in support of the Quality Standards.

In Germany a "Code on Shipbuilding Practice" has been prepared by German Association of Shipbuilders in 1974 {6} which covers the most important phases of shipyard work. In the compilation of this Report it has been considered necessary to prepare a comparison table of the Japaneses Swedish, German and U.S.A. Codes in order to highlight the diferrences between them: see "Appendix A ". It is the firm belief of this Committee that as theoretical and experimental research progress the differences between the codes should become smaller.

8. RECOMMENDATIONS FOR FUTURE RESEARCH

As previously mentioned in the introduction it is only lately that shipbuilding industry has become aware of the importance of imperfections in the ship structure and has started work with the objective of establishing a relationship between a certain defect-whether design or fabrication - and the strength of the Structure. The formation of this Committee is probably the best indication of this need.
A considerable amount of work has still to be done in collecting statistical data on:

1) The deformation of main and secondary structural members during various loading conditions.

2) The misalignment of main and secondary members such as shell plates, frames, floors, girders, brackets etc.

3) The damages of ships in service, their location, size, type, environmental conditions, propagation characteristics etc.

To this effect the assistance of the Classification Societies in cooperation with Shipyards and Owners is absolutely necessary.
A comprehensive Damage Recording System should be established by which Classification surveyors should be able to record all particulars of damages.
Damages statistics should cover a wider spectrum then presently foreseen by most Classifications. At present only damages of an unusual nature or severe enough to require renual of structural members are included in the Technical File.
A much more detailed description of the damage including a small sketch with dimensions and geometry of the adjoining area would be desirable if accurate evaluation of the damage is to be made. To avoid loss of time standard typical sketches can be prepared for most parts of the structure.
A file and retrieval system should be operated by each Society in order to produce the necessary compilation of information. What is more important is that all parties concerned, mainly Classification Societies Shipowners and Shiprepairs to take a more liberal view of the subject and release this valuable information for the benefit of all concerned.

Future Research is recommendation the following areas:

needed to perform an accurate evaluation of casualties. In another section they point out that many damages are recorded under "heavy weather damage" for convenience, and only very detailed reports would allow scientific investigators to determine the true causes. They also state; "Information from damage reports is seldomly sufficient in detail and reliable enough to allow for evaluation of failures[1]".

The specific type of data that is needed is that which has been discussed in Section 4 and under microscopic data in Section 5. An example of conclusions that can be drawn from analyzing such data is given in Figure 6-2 which has been reproduced from Reference 7.

For purposes of comparison it is of interest to compare Figure 6-2 to the example of macroscopic data given in Section 5.3.3.

(1) Reference 8, III.3-4

Figure 6-2: Conclusions from; "Tanker Structural Analysis for Minor Collisions - Collision Inspection Reports (7)"

Analyses of the results of the six ships' collision inspection cases have brought forth the following generalized conclusions:

(1) The bow of the striking ship distorts significantly only if it encounters relatively stiff horizontal resistance at a deck or bilge.

(2) The longitudinal extent of damage is the same for the deck, shell plate, and all damaged longitudinals.

(3) The energy absorption capacity of a longitudinally framed ship is generally greater than that of a comparable transversely framed ship.

(4) The longitudinal extent of damage is likely to be restricted between the transverse bulkheads and/or strong web frames.

(5) The deck and bilge area are "hard points" in resisting side incursion unless the striking bow directly bears against them.

(6) The relative location of strike to the transverse bulkhead has a significant effect on energy absorption.

(7) For a longitudinally stiffened hull, the collision energy is primarily absorbed by membrane tension in the side shell plate and longitudinal stiffeners.

(8) For a double-skin struck ship, web plates are more effective than web trusses for causing the two skins to distort in unison.

(9) In an oblique collision, the angle of collision remains constant throughout the collision.

(10) For oblique collisions, plastic membrane-tension strains occur in the portion of hull behind the strike.

(11) The damaged deck forms a series of small-pitch accordion folds extending in the longitudinal direction.

7. EXISTING DAMAGE RECORDS - DESCRIPTION AND EVALUATION

7.1 Introduction

The purpose of this section is to identify and evaluate sources of casualty data. The evaluations will be based on the possible use of the data in setting priorities for research studies and for possible use in research and design.

Various organizations have been accumulating casualty data for many years. In most cases this data has been for purposes other than structural analysis; predominantly for litigation and law enforcement purposes.

7.2 Identification of Data Sources

The following list of structural casualty data sources has been identified:

- U.S. Navy CASREPT System
- United States Coast Guard Structural Failure Reports, Form CG-2752
- USCG Vessel Casualty Reports, Form CG-2692
- United States Salvage Association
- The Salvage Association of London
- Tanker Advisory Center
- American Bureau of Shipping
- Maritime Administration
- Military Sealift Command
- Lloyd's Register of Shipping
- Lloyd's List

- Marine Management Systems, Inc.
- Liverpool Underwriters' Association
- Ship Owners

7.3 Evaluation of Data Sources

7.3.1 Introduction

A brief evaluation of each identified structural casualty data source is given below. The evaluation is based on the possible use of the data in establishing priorities for research studies and for possible use in research and design.

The specific data needed for establishing priorities for research studies has been described in section 5. The specific data required for use by researchers and designers has been described in section 6.

Appendix A contains a more detailed description of the data sources, and in some cases, a sample of the data. Appendix C contains a list of organizations/individuals that were contacted.

7.3.2 U.S. NAVY CASREPT SYSTEM

Generally, only equipment failures are reported, this being the original intent. Some structural casualty data exists for collisions and groundings. Damage reports are received from all vessels in the active fleet.

Data from this source would only be available through government channels and then only if it were unclassified.

Since the data is mainly for equipment, for Navy ships, and difficult to obtain, this source does not appear to be significant for studies of merchant ship structural casualties.

7.3.3 UNITED STATES COAST GUARD

The USCG has data bases from the following three sources:

- U.S. Salvage Data that is sold to the USCG
- Form CG-2692 - Report of Vessel Casualty or Accident
- Form CG-2752 - Report of Structural Failure, Collision Damage or Fire Damage to Inspected Vessel

The U.S. Salvage Data is described in Section 7.3.4. The USCG does not intend to make that data publicly available.

The largest data base appears to be form CG-2692. This form includes damage cost, but vessel lay-up time is not noted. The present collection rate of these forms is 5000 per year. Some of the more serious casualties have been investigated by U.S. Coast Guard Marine Board of Investigation. In such cases more detailed information may be available.

Enough data should exist to evaluate the cost effectiveness of macroscopic research projects. The Marine Board investigations may provide some data for microscopic research projects, research and design.

Form CG-2752 appears to be less valuable than CG-2692 since there are fewer in number and many details, including cost of repair, are not recorded. Ideally, (as intended) this form should include very detailed descriptions of the damage including photos and sketches, but this is generally not the case.

7.3.4 UNITED STATES SALVAGE ASSOCIATION

The USSA data exists in two forms; the detailed survey reports and electronic data processing (EDP) cards. The data for the latter comes from the former.

According to USSA the detailed reports are not currently available to the public. In the future, such reports might be made public by removing proprietary information (Procedure and funding has not been considered yet.) USSA feels the EDP data is currently available to the public through the USCG. The USCG does not agree.

The USSA data would be adequate for the cost-effectiveness evaluation of macroscopic research projects. Cost of repairs and lay-up time are available. MR&S had determined some years ago, during the course of performing the work of Reference 6, that the USSA detailed reports did not contain adequate information for structural analysis and verification of results.

7.3.5 THE SALVAGE ASSOCIATION OF LONDON

The SAL was surveyed by mail.

Detailed reports of damage are made of all ships surveyed. The ships are mainly those on the London Insurance Market. Information Retrieval Cards are completed from the data in the detailed reports.

SAL has indicated that their interests and information in the detailed reports do not include data concerned with structural analysis of the damage. Cost of damage repair and lay-up time is noted.

No data has been computerized. SAL has not indicated the size of their data base.

It does appear that the type of data at SAL would be useful in an evaluation of the cost-effectiveness of macroscopic research projects only. The availability of the ata is unknown (although SAL was asked they did not respond).

7.3.6 LLOYD'S LIST

Lloyd's List contains casualty data on marine, non-marine and aviation casualties. The sources of data include news services, classification societies, and insurance company representatives.

Shipyards make use of Lloyd's List to identify possible repair work.

The amount of detail in the damage descriptions varies but it is always brief. Costs of repair and lay-up time are not noted since casualties are reported shortly after they occur and before estimates of damage have been made. The data is available to the public.

It appears the more complete Lloyd's List reports could be used as a data base to perform studies on the cost effectiveness of macroscopic research studies if damage cost and lay-up time could be estimated.

7.3.7 AMERICAN BUREAU OF SHIPPING

Since 1965 the ABS has been collecting casualty data on ABS-classed vessels. Data is available on about 9,000 ships.

The detailed reports are proprietary and do not contain enough information for structural analysis. In addition they do not contain the cost of damage and lay-up time data. A computerized form of data includes a short abstract of the casualty.

The ABS data should be of use for the evaluation of cost-effectiveness of macroscopic research programs if cost and lay-up time data can be estimated.

7.3.8 LLOYD'S REGISTER OF SHIPPING

Lloyd's data and its availability appear to be similar to ABS.

Lloyd's claims to have a larger data base than ABS. The number of new reports per annum is claimed to be 40,000.

Without having seen the detailed reports or having spoken to someone who is intimately familiar with the detailed hull structure reports, it is assumed the same kind of data exists as in ABS reports.

7.3.9 TANKER ADVISORY CENTER

Data is limited to petroleum product carriers. Data is taken from Lloyd's List. Data can be purchased.

Because of its limited nature the data is not particularly useful for the purposes considered herein.

7.3.10 MARINE MANAGEMENT SYSTEMS, INC.

This organization gets its data from the Tanker Advisory Center and consequently the same applies.

7.3.11 LIVERPOOL UNDERWRITER'S ASSOCIATION

Although samples were not obtained, Reference 9 implies that the data is of the macroscopic type since, for the ships listed therein, the location of damage (collision) on the ship was generally not noted.

7.3.12 MARITIME ADMINISTRATION

Detailed information on this data was not obtained since Reference 1 indicated it is of a limited nature.

7.3.13 MILITARY SEALIFT COMMAND

Detailed information on this data was not obtained since Reference 1 indicated it is of a limited nature.

8. AVAILABLE DATA ANALYSIS SYSTEMS

8.1 Introduction

In order to assess available and future structural casualty reports to establish research program priorities, data analysis systems are necessary. The purpose of this section is to describe and evaluate both existing methods and those under development.

8.2 List of Data Analysis Systems

Those computer data analysis systems existing or under development that have been identified in this study are as follows:

- U.S. Salvage Association (existing)
- U.S. Coast Guard (existing)
- U.S.C.G. by Battelle Memorial Institute (under development)
- ABS ABSIRS (existing)
- Lloyd's Register of Shipping (existing)

8.3 Evaluation of Data Analysis Systems

8.3.1 Introduction

Below a brief evaluation of each identified computer data analysis system is given.

Appendix B contains a more detailed description of the data analysis systems. Appendix C contains a list of organizations/individuals that were contacted.

8.3.2 U.S. Salvage Association

The computer program developed uses the USSA punch card data (see Section 7) as the source. The program considers various variables for retrieving the data, such as: alleged cause, affected elements, type of vessel,

etc. The specific output can include individual and average repair costs per vessel: and individual and average time for repair for specific affected elements, by casualty, by cause or by type of vessel.

The program or output is not available to the public in any form. USSA has not made use of the program yet (although they have made a few sample runs as described in Appendix B), but have requests from the American Hull Insurance Syndicate.

Structurally affected elements are described only as floors, framing, plating, and shafting, for example. The program seems applicable for analyzing some macroscopic research projects.

8.3.2 U.S. Coast Guard

A computer program that uses data from form CG-2692 has been in existence since 1963.

This program appears to manipulate data in a way similar to the USSA program. The data coded seems to be slanted more towards regulating and litigation than the USSA data however, and consequently very few purely structural aspects are considered.

Estimated damage cost is coded.

This existing program seems applicable for analyzing some macroscopic research projects.

8.3.3 U.S. Coast Guard - Battelle Memorial Institute

The Battelle computer program has not yet been developed. The basic characteristics have been outlined, however.

Although the program should have significantly more entries with respect to structures than the USCG program described in Section 8.3.2, it may not consider the type of data required in microscopic studies. Further, when the program is first put into use, it will have to rely on the existing data base which does not contain extensive microscopic data (a new data collection form is to be developed in conjunction with the program).

The program should be useful for analyzing at least macroscopic research projects.

8.3.4 American Bureau of Shipping

The ABSIRS data analysis system in conjunction with the Hull Technical Note data file indicates a possibility of being useful for evaluating macroscopic research program priorities. It is a modified version of the IBM General Information System Computer program.

The structural items considered appear to be more extensive and detailed than those in the USCG program or USSA program. Cost data output is not available.

A previous user has indicated the program requires extensive user interface and considerable funds.

8.3.5 Lloyd's Register of Shipping

Appears to be similar to ABS but with a larger data base.

9. GENERAL DATA COLLECTION AND ANALYSIS

The type of data that is currently collected and analyzed should be adequate to evaluate macroscopic research projects.

The type of data necessary for evaluating microscopic research projects and aiding researchers have been described in Sections 5 and 6 respectively.

In the future, if the desire to collect data suitable for the analysis of microscopic research projects and for aiding researchers should develop, the information described in Sections 5 and 6 should be collected.

10. CONCLUSIONS

- A format for a formal reliability analysis of the ship from the standpoint of its capability to perform its mission at minimum repair costs has been presented. It is based on work done in the electronics and flight vehicle propulsion systems fields.

- The type of casualty data necessary for establishing research project priorities has been identified. It is either of the macroscopic or microscopic type. Microscopic data is associated with the detailed description of specific types of structural failure and deformation while macroscopic data is concerned with the description of the general nature and circumstances of the overall structural casualty.

- Data necessary in aiding researchers in developing new techniques and analyses has been identified.

- Existing casualty damage records have been identified and evaluated. All of the data appears useful for establishing priorities of macroscopic research projects only. It does not appear useful for microscopic research projects and as an aid in developing new techniques and analyses. Most

data bases are not publicly available. Some of these can be utilized for a fee.

- The USCG data form CG-2692 appears to be the most useful and extensive publicly available data base. The cost data represent the repair cost of casualties only and not the lost revenues due to the ship being out of service. Of course, the latter can be estimated. Further, the USCG data are for U.S. flag ships only.

- Existing data analysis systems have been identified and evaluated. All systems are for manipulating data useful for macroscopic research projects. Most systems are not publicly available. Most of those that are not available can be utilized for a fee.

- The USCG computer data analysis system (which utilizes data from form CG-2692 as a data base) appears to be the most useful publicly available system.

- Presently, it appears that a study in establishing research project priorities would only be substantially successful for macroscopic research projects. Perhaps a detailed evaluation of many CG-2692 reports and associated Marine Board of Investigation reports(when developed) and others would turn up enough information to make some decisions on microscopic research projects; however, this is not obvious.

11. RECOMMENDATIONS

11.1 Introduction

The recommendations for future work based on the present study are divided into short-term and long-term categories. The reason behind such a division is that data presently available appears to be primarily applicable to studies concerned with macroscopic aspects of casualties. To address the microscopic aspects, new, more comprehensive data would have to be collected over a significant period of time.

11.2 Short-Term Recommendations

a. Initiate a research project to develop a procedure for evaluating the cost-effectiveness of macroscopic research projects. The project should:

- Make use of the existing USCG data bases (collected and computer) and data analysis program.
- Review the collected data base in detail to determine additional potential over that indicated by the existing data analysis computer program (whose data base is a subset of the collected data).
- Incorporate those changes in the data analysis program necessary to utilize the greater potential of the collected data that would require, at most, a modest overhaul of the program.
- Develop the needed computer data base for the overhauled program from the existing collected data base.

- Develop a procedure to evaluate the total damage cost including; cost of repair, off charter losses, expenses while laid-up. Incorporate the procedures or results in the data analysis program.
- Perform research program cost-effectiveness studies.

b. Interface with USCG-Battelle Memorial Institute to assure that provisions are made in both the data collection scheme and data analysis computer program to adequately provide for structural casualty data and analysis from both a macroscopic and microscopic standpoint.

c. Research to develop structural casualty data forms for casualty inspectors. These forms should provide for collection of data needed to analyze macroscopic and microscopic research projects and should provide the detailed information that researchers require to perform studies.

11.3 Long-Term Recommendations

a. Collect the detailed data for which forms are developed under Section 11.2, c.

b. Investigate further the possibilities of a central data collection agency independent of the various field collection agencies.

c. Develop a computer analysis system to manipulate and analyze the data of a.

12. REFERENCES:

1. Hawkins, S., et. al., "A Limited Survey of Ship Structural Damage," SSC-220, 1971.

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3. Evans, J.H., Ship Structural Design Concepts, Ship Structure Committee, 1974.

4. Matoba, M., Comparative Study of Fatigue Data Obtained Using Scale Models and Test Specimens of Typical Welded Joints, JSNAJ, December 1975 (in Japanese).

5. Review and Recommendations for the Interagency Ship Structure Committee's Fiscal 1977 Research Program, National Academy of Sciences, March 1976.

6. "Tanker Structural Analysis for Minor Collisions," prepared for U.S. Coast Guard by M. Rosenblatt & Son, Inc. and U.S. Steel, MR&S Report No. 2087-18, December 1975.

7. "Tanker Structural Analysis for Minor Collision - Collision Inspection Reports," prepared for U.S. Coast Guard by MR&S and U.S. Steel, MR&S Report No. 2087-20, December 1975.

8. "Fabrication Factors Affecting Structural Capability of Ships and Other Marine Structures," 6th International Ship Structures Congress, Report of Committee III.3, 1976.

9. Ship Casualty Data Analysis, Report No. MA-RP-920-76048, Maritime Administration, November 1975.

APPENDIX A

SAMPLES OF RECORDS

U.S. NAVY CASREPT SYSTEM

- CASREPT stands for Casualty Reporting System.
- Method for reporting equipment failures and the effects of these failures on the capability of the reporting unit to perform its assigned mission.
- The Fleet Material Support Office, Mechanicsburg, Pennsylvania is the data collection center.
- Reports are continuously submitted by the active fleet.
- The data collected is utilized in the production of reports for use by commands throughout the Navy. The reports are designed to assist in identifying problem equipments.
- There is some structural casualty information, for example, on collision and grounding. Most of the data is for equipment however.
- Sample data can only be obtained by requesting it through NAVSEC.

U.S. COAST GUARD

- Data bases are from the following three sources:
  1. U.S. Salvage Data that is sold to the USCG.
  2. Form CG-2692 - Report of Vessel Casualty or Accident
  3. Form CG-2752 - Report of Structural Failure, Collision Damage or Fire Damage to Inspected Vessel

- The U.S. Salvage Data base is discussed under that company. The USCG does not intend to make this data available to the public.
- CG-2692 is submitted by ship's Master or company agent for each casualty involving $1500 or more damage, to U.S. flag vessels, occurring anywhere in the world. Along with these form reports, the CG sometimes receives narrative reports for inclusion in the casualty files.
- MR&S chose eight sample CG-2692 reports from a group of thirty. These eight were either more complete in themselves than the others or were supplemented by narratives. Enclosure (USCG-1) includes a blank CG-2692 form and a summary of the data contained in the eight sample reports that were reviewed.
- In the case of some of the more severe casualties, the USCG convenes Marine Boards of Investigation to analyze the situation in more detail. Extensive studies are usually performed and reports written. These are also available.

- The Coast Guard receives CG-2752 forms from OCMI offices for casualties that occur to inspected vessels in U.S. waters. MR&S obtained three copies of these reports. Enclosure (USCG-2) includes a sample form and a summary of the data contained in the three sample reports that were reviewed.

- CG-2692 forms have been collected since the end of WW II. The present collection rate of these reports is 5000/year.

- Present collection rate of CG-2752 form is not known.

- Both the CG-2692 reports and the CG-2752 reports can be purchased from the U.S. Coast Guard.

- The CG-2692 forms have damage repair cost. Lay-up time of vessel is not noted.

- The data from both forms CG-2692 and CG-2752 could be useful for determining the cost effectiveness of macroscopic research programs. Its value for microscopic programs and as a data base for researchers and designers is limited.

- Some Marine Board of Investigation Reports may contain some microscopic data.

ENCLOSURE (USCG-1)

CG-2692 Report of Vessel Casualty or Accident and Marine Inspection Investigating Officer's Cover Letter Plus Narratives

I. Particulars of Vessel (mostly facts available from the ABS Record)

For all 8 vessels covered in the 5 casualty reports, this section was nearly complete. 1 official number was omitted, 1 answer for (11) radio equipment was omitted, and 1 set of answers for (13a), (13b), (14b), (14c), and (15b) was omitted, each type of omission occurring on different forms.

II. Particulars of Casualty

Again, all 8 CG-2692 forms were nearly complete in the items (17) through (29). Note that (28), loss/damage, was answered in all cases, but in the DIAMANTIS PATERAS collision with the pier (File 52599), the estimate for damage to pier in this apparently minor collion was $400,000.

(30) "Description of casualty" and (31) " Damage" both leave large spaces which are good as encouragement to the person filling in the form to supply data not covered by the previous items, in narrative form. In the SS JAMES LYKES etc. case (File 50503) where action against license was taken, lengthy reports compiled from narratives of the involved personnel have been attached. It is evident that the data gatherers for these narratives are well versed in the procedures for describing the casualty circumstances and events. However, they seem much less familiar with structural analysis techniques and hence supply scant damage descriptions. In the M/V TRYM (File 52600) collision with a bridge, the master described the damage to the vessel as a dent on the starboard side in way of the #1 hold. In his own report, appended to the file, the lockmaster described the damage to the bridge item by item, including a

"bent" code for each structural member. The best damage descriptions were for the SANTA MARIANA (file 60155) "Stove in #1 Port sideport, and aft frame of sideport opening bent in 3 inches." and the barge GDM 60 (File 50503) " #4 starboard tank holed for full depth" by the freighter JAMES LYKES. Neither of these descriptions provide sufficient data for a rigorous structural analysis.

III. Assistance and Recommendations

In the case of the DIAMANTIS PATERAS (File 52599) the operations manager of the shipping company recommended "Greater turning space in area is needed," and in the case of the JAMES LYKES (File 50503) the master recommended "Tugs should refrain from remaking tows in channel, attend radio net, and communicate with traffic."

Only one CG-2692 was filled in by a CG inspecting officer [ALPHA O, (File 60180)]. The remaining forms were completed by masters, agents, or attorneys (for company).

DEPARTMENT OF TRANSPORTATION U. S. COAST GUARD CG-2692 (Rev. 3-67)	**REPORT OF VESSEL CASUALTY OR ACCIDENT**	Form Approved Budget Bureau No. 48-R114.5 REPORTS CONTROL SYMBOL MVI-4017

INSTRUCTIONS

1. An original and two copies of this form shall be submitted, without delay, to the Officer in Charge, Marine Inspection, in whose district the casualty occurred, or in whose district the vessel first arrived after such casualty.
2. If the person making the report is a licensed officer on a vessel required to be manned by such officer, he must make the report in writing and in person to the proper Marine Inspector. If because of distance it may be inconvenient for such an officer to submit the report in person, he may submit the required number of copies by mail. However, to avoid delay in investigations, it is desired that reports be submitted in person.
3. This form should be completed in full; blocks which do not apply to a particular case should be indicated as "NA". Where answers are unknown or none, they should be indicated as such. All copies should be signed.

NOTE: (1) Report all deaths and injuries, which incapacitate in excess of 72 hours, on CG-924E whether or not there was a vessel casualty.
(2) Attach separate Form CG-924E to this report for each person killed or injured and incapacitated in excess of 72 hours as a result of the vessel casualty reported herein.

TO: Officer in Charge, Marine Inspection, Port of	DATE SUBMITTED

I PARTICULARS OF VESSEL

1. NAME OF VESSEL	2. OFFICIAL NUMBER	3. HOME PORT	4. NATIONALITY
5. TYPE OF VESSEL *(Frt., pass., tkr., etc)*	6. PROPULSION *(Steam, diesel, etc)*	7. GROSS TONNAGE	8. REGISTERED LENGTH OR L O A
9. HULL MATERIALS	10. YEAR BUILT	11. RADIO EQUIPMENT ☐ TRANSMIT ☐ RECEIVE ☐ VOICE ☐ CW *(Key)*	
12. (a) RADAR EQUIPPED ☐ YES ☐ NO		(b) IF YES, RADAR OPERATING AT TIME OF CASUALTY ☐ YES ☐ NO	
13. (a) CERTIFICATE OF INSPECTION ISSUED AT PORT OF		(b) DATE CERTIFICATE OF INSPECTION ISSUED	
14. (a) NAME OF MASTER OR PERSON IN CHARGE *(Indicate which)*		(b) DATE OF BIRTH	(c) LICENSED BY COAST GUARD ☐ YES ☐ NO
15. (a) NAME OF PILOT *(If on board at time of accident)*		(b) PILOT SERVING UNDER AUTHORITY OF LICENSE ISSUED BY ☐ USCG ☐ STATE ☐ FOREIGN	
16. (a) NAME OF OWNER(S), OPERATOR(S) OR AGENT *(Indicate which)*		(b) ADDRESS OF OWNER(S), OPERATOR(S), OR AGENT	

II PARTICULARS OF CASUALTY

17. (a) DATE OF CASUALTY	(b) TIME OF CASUALTY *(Local or zone)*	(c) ZONE DESCRIPTION	(d) TIME OF DAY ☐ DAY ☐ NIGHT ☐ TWILIGHT
18. LOCATION OF CASUALTY *(Latitude and longitude; distance and TRUE bearing from charted object; dock; anchorage; etc.)*			
19. BODY OF WATER *(Geographical name)*	20. RULES OF THE ROAD APPLICABLE ☐ INLAND ☐ GREAT LAKES ☐ WESTERN RIVERS ☐ INTERNATIONAL ☐ OTHER *(Specify)*		
21. (a) DID CASUALTY OCCUR WHILE UNDERWAY: ☐ YES ☐ NO			
(b) IF YES, LAST PORT OF DEPARTURE		(c) IF YES, WHERE BOUND WHEN CASUALTY OCCURRED	

22. (a) WEATHER CONDITIONS WHEN CASUALTY OCCURRED: ☐ CLEAR ☐ PARTLY CLOUDY ☐ OVERCAST ☐ FOG ☐ RAIN ☐ SNOW ☐ OTHER *(Specify)*					
(b) VISIBILITY *(Miles, yds., ft., etc.)*	(c) WIND DIRECTION		(d) FORCE IN KNOTS	(e) GUSTY ☐ YES ☐ NO	(f) AIR TEMPERATURE
23. (a) SEA CONDITIONS WHEN CASUALTY OCCURRED	(b) SEA WATER TEMP *(If available)*	(c) HEIGHT OF SEA	(d) DIRECTION OF SEA	(e) HEIGHT OF SWELL	(f) DIRECTION OF SWELL

24. (a) NATURE OF CARGO *(Specify)*	(b) AMOUNT OF DRY CARGO *(Long tons)*	(c) AMOUNT OF BULK LIQUID *(Long tons)*	(d) AMOUNT OF DECK LOAD *(Long tons)*
25. (a) DRAFT FORWARD		(b) DRAFT AFT	
26. (a) TYPES OF LIFESAVING EQUIPMENT USED, IF ANY		(b) NO LIVES SAVED WITH LIFESAVING EQUIPMENT	(c) LIFESAVING EQUIPMENT SATISFACTORY ☐ YES ☐ NO *(If no, explain in Item 34)*

27	CREW	PASSENGERS	OTHER (Specify)	28 ESTIMATED LOSS/DAMAGE TO YOUR VESSEL	$
NUMBER ON BOARD				ESTIMATED LOSS/DAMAGE TO YOUR CARGO	$
DEAD/MISSING				ESTIMATED LOSS/DAMAGE TO OTHER PROPERTY	$
INCAPACITATED (over 3 days)				*(Specify whether vessel, dock, bridge, etc.)*	

29 NATURE OF THE CASUALTY *(Check one or more of the following. Give pertinent details in item 30.)*

	COLLISION WITH OTHER VESSEL(S) *(Specify)*		EXPLOSION/FIRE *(Other)*
			GROUNDING
			FOUNDER *(Sinking)*
	COLLISION WITH FLOATING OR SUBMERGED OBJECTS		CAPSIZING WITHOUT SINKING
	COLLISION WITH FIXED OBJECTS *(Piers, bridges, etc.)*		FLOODING, SWAMPING, ETC., WITHOUT SINKING
	COLLISION WITH ICE		HEAVY WEATHER DAMAGE
	COLLISION WITH AIDS TO NAVIGATION		CARGO DAMAGE *(No vessel damage)*
	COLLISION *(Other)*		MATERIAL FAILURE *(Vessel structure)*
	EXPLOSION/FIRE *(Involving cargo)*		MATERIAL FAILURE *(Engineering machinery, including main propulsion, auxiliaries, boilers, evaporators, deck machinery, electrical, etc.)*
	EXPLOSION/FIRE *(Involving vessel's fuel)*		
	FIRE *(Vessel's structure or equipment)*		EQUIPMENT FAILURE
	EXPLOSION *(Boiler and associated parts)*		CASUALTY NOT NAMED ABOVE
	EXPLOSION *(Pressure vessels and compressed gas cylinders)*		

30 DESCRIPTION OF CASUALTY *(Events and circumstances leading to casualty and present when it occurred. Attach diagram and additional sheets, if necessary)*

31 DAMAGE *(Give brief general description and state if vessel is a total loss.)*

III ASSISTANCE AND RECOMMENDATIONS

32 AUTO ALARM TRANSMITTED BY YOUR VESSEL: ☐ YES ☐ NO

33(a) ASSISTANCE RENDERED BY STATIONS AND VESSELS *(Include Coast Guard and other stations and vessels)*	(b) OTHER ASSISTANCE RENDERED

34 RECOMMENDATIONS FOR CORRECTIVE SAFETY MEASURES PERTINENT TO THIS CASUALTY *(Include explanation of unsatisfactory lifesaving equipment)*

TITLE	SIGNATURE

ENCLOSURE (USCG-2)

CG-2752 Report of Structural Failure, Collision Damage, or Fire Damage to Inspected Vessel

Note: under "Instructions," in fine print, Loading Plan and/or other data to indicate longitudinal and vertical distribution of cargo and tankage are requested.

I. Description of Vessel (mostly facts available from the ABS Record)
For all 3 reports, this section was complete.

II. Circumstances Surrounding Casualty

Since all 3 reports were for "Structural Failure", the reporters filled in this section mostly with "N/A" or "-", but it is evident that they paid attention to this section.

III. Structural Failure

The box for class of fracture is coded: 1 - Ship broke or is in imminent danger of breaking. 2- Crack in main structure poses threat of leading to type 1 failure. 3 - All other damages to structure.

Note that "fractures or buckles" within the forward 1/6 length are not called for. For damages or failures elsewhere, the directions request location of failure, general history and contributing factors, and extent of damages to frames, hull plates, and decks. Since the forms are filled out by the cognizant OCMI, more uniformity of report completeness appears here than in CG-2692. However, individual's familiarity with structural analysis techniques vary, hence types of details are likely to vary greatly from reporter to reporter.

Two different reports are appended to show a relatively useful description versus a not so useful description. Note that the CHERRY VALLEY report cited the problem, included a builder's detail drawing reference, gave specific locations of fracture observations, diagnosed the problem, and wrapped up the narrative by describing a remedy that worked and will be required.

IV. Collision Resulting in Structural Damage

Note that data are requested only "when a collision results in the structure of the vessel being HOLED." Thus, dents, no matter how large, are liable to be ignored by the OCMI when he reports casualties. Some specific dimensional information is itemized for holes.

V. Fire/Explosion

Little specific information is requested. The extent of completeness is left to the discretion of the report filer.

Unfortunately, collision and fire/explosion cases were not sampled, so there remains some question of how OCMI's perform data collection for these cases.

VI. Disposition of Vessel

Can range from general statement of repairs made to structural members to specific orders of how to perform the repairs.

TREASURY DEPARTMENT U. S. COAST GUARD CG-2752 (Rev. 2-62)	REPORT OF STRUCTURAL FAILURE, COLLISION DAMAGE OR FIRE DAMAGE TO INSPECTED VESSEL	REPORTS CONTROL SYMBOL MVI-4024 DATE

INSTRUCTIONS

1. Officers-in-Charge, Marine Inspection, shall submit this report direct to the Commandant with a copy to the appropriate District Commander whenever an inspected vessel of over 500 gross tons suffers a class 1 or 2 structural failure, is holed in collision with another vessel or object, or is damaged as a result of fire or explosion. Form CG-2752A should be used to report equipment failures on inspected vessels.
2. Complete Sections I, II and VI on all reports as well as appropriate casualty section(s). To eliminate presumption of oversight enter "NA" under items which are not applicable and indicate as UNKNOWN or NONE items which these terms describe. Where exact or actual information is not available, enter estimate and label "EST"
3. Attach Loading Plan and/or other data to indicate longitudinal and vertical distribution of cargo and tankage.

FROM: Officer-in-Charge, Marine Inspection,	TO: Commandant (MMT) VIA: Commandant (MVI)

I. DESCRIPTION OF VESSEL

NAME (Vessel A of Sec. IV)	OFFICIAL NUMBER	TYPE (Tank, freight, passenger, etc.)	HULL MATERIAL	
GROSS TONS / REG. LENGTH	MARITIME ADMIN. DESIGN (None, Liberty, C-1, T-2, etc.)	BUILDER	HULL NUMBER (Builder's)	DATE COMPLETED
OWNER		OPERATOR		

II. CIRCUMSTANCES SURROUNDING CASUALTY

NATURE OF CASUALTY (Check)

☐ STRUCTURAL FAILURE ☐ COLLISION ☐ FIRE/EXPLOSION

DATE OF CASUALTY	TIME (Local)	SHIP'S LOCATION (Latitude and longitude; distance and true bearing from charted object, dock, anchorage, etc.)

WEATHER (Check)

☐ CLEAR ☐ PARTLY CLOUDY ☐ OVERCAST ☐ FOG ☐ RAIN ☐ SNOW ☐ OTHER (Specify)

HEIGHT OF SEA	DIRECTION OF SEA	HEIGHT OF SWELL	DIRECTION OF SWELL	SEA WATER TEMPERATURE	WIND DIRECTION	WIND FORCE IN KNOTS	AIR TEMPERATURE

SHIP'S SPEED (At time of casualty)	SHIP'S COURSE (True) (At time of casualty)	DRAFT FWD (Immediatly before casualty)	DRAFT AFT (Immediately before casualty)

III. STRUCTURAL FAILURE

(Complete if a fracture or buckle has occurred in the shell, decks, or inner bottom within the amidship 2/3 length or in the stern frame. Sketches, plans or photos showing damages and extent of failure, apparent starting point or points, relative location of welds and other structural features and details of proposed or completed repairs should also be attached)	CLASS FRACTURE

DESCRIPTION OF FAILURE OR DAMAGE (Locate where failure started with respect to welds and other structural features, general history and any contributing factors, extent of damages to frames, hull plates and decks. Use additional sheets as necessary.)

PREVIOUS EDITIONS ARE OBSOLETE 25338 TREAS. CGHQ. WASH., D.C.

IV. COLLISION RESULTING IN STRUCTURAL DAMAGE

(Complete only when a collision results in the structure of the vessel being HOLED. A separate form should be completed on each vessel holed as a result of collision. The name and official number of each other vessel involved should be shown below. It is important to determine the location of damage, extent of flooding, and resulting heel, trim and draft. Use additional sheets if necessary, and photos of damage, if possible.)

GENERAL DESCRIPTION OF COLLISION AND RESULTING DAMAGE TO VESSEL "A", i.e. SUBJECT VESSEL OF THIS REPORT *(Use sketch to indicate angle of collision and give brief description of damage. If vessel sank, give number of minutes to sink, behavior during sinking, number of lives lost and number saved.)*

VESSEL "A" EXTENT OF DAMAGE	LONGITUDINAL EXTENT OF HOLING *(Measured in feet from bow or stern. Indicate which)*		TRANSVERSE EXTENT OF HOLING *(Approx. feet in from side)*	DESCRIPTION OF VERTICAL EXTENT OF DAMAGE *(List decks or flats penetrated)*
	FWD EDGE OF HOLE	AFT EDGE OF HOLE		
AT BULKHEAD OR WEATHER-DECK *(Indicate)*				

DEGREES HEEL AFTER FLOODING *(Indicate port or starboard)*	DRAFT FWD *(After flooding)*	DRAFT AFT *(After flooding)*

OTHER VESSELS OR OBJECTS INVOLVED		NAME *(Vessel or object)*	OFFICIAL NUMBER		NAME *(Vessel or object)*	OFFICIAL NUMBER
	B			E		
	C			F		
	D			G		

V. FIRE/EXPLOSION

SOURCE *(Where and how started)*	EXTENT OF DAMAGES *(Areas damaged by smoke, fire and/or explosion)*

FIRE DETECTING AND EXTINGUISHING SYSTEMS INSTALLED IN DAMAGED AREAS *(Describe equipment and effectiveness)*

VI. DISPOSITION OF VESSEL

☐ TOTAL LOSS *(Sunk or scrapped)* ☐ LAID UP OR STORED WITHOUT REPAIRS ☐ TEMPORARY REPAIRS *(Describe)* ☐ PERMANENT REPAIRS *(Describe)* ☐ OTHER *(Specify and describe)*

REPORT INCLUDES INFORMATION UP TO THIS DATE	NAME AND TITLE *(Typed)*	SIGNATURE

DEPARTMENT OF TRANSPORTATION U. S. COAST GUARD CG-2752 (Rev. 3-67)	REPORT OF STRUCTURAL FAILURE, COLLISION DAMAGE OR FIRE DAMAGE TO INSPECTED VESSEL	REPORTS CONTROL SYMBOL MVI-4024 DATE 30 August 1976

INSTRUCTIONS

1. Officers-in-Charge, Marine Inspection, shall submit this report direct to the Commandant with a copy to the appropriate District Commander whenever an inspected vessel of over 500 gross tons suffers a class 1 or 2 structural failure, is holed in collision with another vessel or object, or is damaged as a result of fire or explosion. Form CG-2752A should be used to report equipment failures on inspected vessels.
2. Complete Sections I, II and VI on all reports as well as appropriate casualty section(s). To eliminate presumption of oversight enter "NA" under items which are not applicable and indicate as UNKNOWN or NONE items which these terms describe. Where exact or actual information is not available, enter estimate and label "EST"
3. Attach Loading Plan and/or other data to indicate longitudinal and vertical distribution of cargo and tankage.

FROM: Officer-in-Charge, Marine Inspection, Baltimore, Maryland

TO: Commandant (MMT)
VIA: Commandant (MVI)

I. DESCRIPTION OF VESSEL

NAME (Vessel A of Sec. IV)	OFFICIAL NUMBER	TYPE (Tank, freight, passenger, etc.)	HULL MATERIAL
CHERRY VALLEY	557503	Tankship	Steel

GROSS TONS	REG. LENGTH	MARITIME ADMIN. DESIGN (None, Liberty, C-1, T-2, etc.)	BUILDER	HULL NUMBER (Builder's)	DATE COMPLETED
22357.66	662.5'	T-6-S-93A	Nat'l Steel Shipbuilding Co. San Diego, Calif.	385	1974

OWNER	OPERATOR
Margate Shipping Company	Keystone Shipping Company

II. CIRCUMSTANCES SURROUNDING CASUALTY

NATURE OF CASUALTY (Check)

[X] STRUCTURAL FAILURE [ ] COLLISION [ ] FIRE/EXPLOSION

DATE OF CASUALTY	TIME (Local)	SHIP'S LOCATION (Latitude and longitude; distance and true bearing from charted object, dock, anchorage, etc.)
N/A	N/A	N/A

WEATHER (Check) N/A

[ ] CLEAR [ ] PARTLY CLOUDY [ ] OVERCAST [ ] FOG [ ] RAIN [ ] SNOW [ ] OTHER (Specify)

HEIGHT OF SEA	DIRECTION OF SEA	HEIGHT OF SWELL	DIRECTION OF SWELL	SEA WATER TEMPERATURE	WIND DIRECTION	WIND FORCE IN KNOTS	AIR TEMPERATURE
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

SHIP'S SPEED (At time of casualty)	SHIP'S COURSE (True) (At time of casualty)	DRAFT FWD (Immediatly before casualty)	DRAFT AFT (Immediately before casualty)
N/A	N/A	N/A	N/A

III. STRUCTURAL FAILURE

(Complete if a fracture or buckle has occurred in the shell, decks, or inner bottom within the amidship 2/3 length or in the stern frame. Sketches, plans or photos showing damages and extent of failure, apparent starting point or points, relative location of welds and other structural features and details of proposed or completed repairs should also be attached)	CLASS FRACTURE Class 3

DESCRIPTION OF FAILURE OR DAMAGE (Locate where failure started with respect to welds and other structural features, general history and any contributing factors, extent of damages to frames, hull plates and decks. Use additional sheets as necessary.)

1. The extent of Class 3 fractures in this vessel would indicate a class problem.
2. Internal inspection of all wing tanks showed a high incidence of fractures of 4" or less in length in the radius cutouts for longitudinals in the web frames. (See enclosed NASSCO Standard Detail #24 for Location of Fractures). The fractures occurred in the following locations: Shell Longitudinal Cutouts #16-22, Bottom Longitudinal Cutouts #9-12, and Bulkhead Longitudinal Cutouts #2, 4, 5 and 7. The majority of the fractures occurred in the Shell Longitudinal Cutouts and in the Port Wing Tanks (see List of Fractures).
3. The cause of the fractures appear to be a design problem. No fractures were noted where Collar plates were installed originally from the underside of the longitudinal to web frame.

PREVIOUS EDITION MAY BE USED

IV. COLLISION RESULTING IN STRUCTURAL DAMAGE

(Complete only when a collision results in the structure of the vessel being HOLED. A separate form should be completed on each vessel holed as a result of collision. The name and official number of each other vessel involved should be shown below. It is important to determine the location of damage, extent of flooding, and resulting heel, trim and draft. Use additional sheets if necessary, and photos of damage, if possible.)

GENERAL DESCRIPTION OF COLLISION AND RESULTING DAMAGE TO VESSEL "A", i.e. SUBJECT VESSEL OF THIS REPORT *(Use sketch to indicate angle of collision and give brief description of damage. If vessel sank, give number of minutes to sink, behavior during sinking, number of lives lost and number saved.)*

N/A

VESSEL "A" EXTENT OF DAMAGE	LONGITUDINAL EXTENT OF HOLING *(Measured in feet from bow or stern. Indicate which)*		TRANSVERSE EXTENT OF HOLING *(Approx. feet in from side)*	DESCRIPTION OF VERTICAL EXTENT OF DAMAGE *(List decks or flats penetrated)*
	FWD EDGE OF HOLE	AFT EDGE OF HOLE		
AT BULKHEAD OR WEATHER-DECK (Indicate)	N/A	N/A	N/A	N/A

DEGREES HEEL AFTER FLOODING *(Indicate port or starboard)*	DRAFT FWD *(After flooding)*	DRAFT AFT *(After flooding)*
N/A	N/A	N/A

OTHER VESSELS OR OBJECTS INVOLVED		NAME *(Vessel or object)*	OFFICIAL NUMBER		NAME *(Vessel or object)*	OFFICIAL NUMBER
	B			E		
	C	N/A	N/A	F	N/A	N/A
	D			G		

V. FIRE/EXPLOSION

SOURCE *(Where and how started)*	EXTENT OF DAMAGES *(Areas damaged by smoke, fire and/or explosion)*
N/A	N/A

FIRE DETECTING AND EXTINGUISHING SYSTEMS INSTALLED IN DAMAGED AREAS *(Describe equipment and effectiveness)*

N/A

VI. DISPOSITION OF VESSEL

☐ TOTAL LOSS *(Sunk or scrapped)* ☐ LAID UP OR STORED WITHOUT REPAIRS ☐ TEMPORARY REPAIRS *(Describe)* ☒ PERMANENT REPAIRS *(Describe)* ☐ OTHER *(Specify and describe)*

1. Web frame at side shell longitudinal cutouts - Locate and drill end of fracture, "Vee" and weld. Install collar plate in way of cutout as per NASSCO Standard Detail #24.

REPORT INCLUDES INFORMATION UP TO THIS DATE	NAME AND TITLE *(Typed)*	SIGNATURE
30 August 1976	K. B. SCHUMACHER Captain, USCG	K B Schumacher

VI. DISPOSITION OF VESSEL (continued)

2. Web frame at bottom and bulkhead longitudinal cutouts - Locate and drill 5/8" hole at end of fracture. If fracture greater than 1 1/2" long, "Vee" and weld. Keystone and Coast Guard to examine at next drydocking.

DEPARTMENT OF TRANSPORTATION
U. S. COAST GUARD
CG-2752 (Rev. 3-67)

REPORT OF STRUCTURAL FAILURE, COLLISION DAMAGE OR FIRE DAMAGE TO INSPECTED VESSEL

REPORTS CONTROL SYMBOL MVI-4024

DATE 21 July 1976

INSTRUCTIONS

1. Officers-in-Charge, Marine Inspection, shall submit this report direct to the Commandant with a copy to the appropriate District Commander whenever an inspected vessel of over 500 gross tons suffers a class 1 or 2 structural failure, is holed in collision with another vessel or object, or is damaged as a result of fire or explosion. Form CG-2752A should be used to report equipment failures on inspected vessels.
2. Complete Sections I, II and VI on all reports as well as appropriate casualty section(s). To eliminate presumption of oversight enter "NA" under items which are not applicable and indicate as UNKNOWN or NONE items which these terms describe. Where exact or actual information is not available, enter estimate and label "EST".
3. Attach Loading Plan and/or other data to indicate longitudinal and vertical distribution of cargo and tankage.

FROM: Officer-in-Charge, Marine Inspection, Hampton Roads, Norfolk, Virginia

TO: Commandant (MMT)
VIA: Commandant (MVI)

I. DESCRIPTION OF VESSEL

NAME (Vessel A of Sec. IV): INTERSTATE 70
OFFICIAL NUMBER: 540401
TYPE (Tank, freight, passenger, etc.): Tank Barge
HULL MATERIAL: Steel
GROSS TONS: 5248.21
REG. LENGTH: 350'
MARITIME ADMIN. DESIGN (None, Liberty, C-1, T-2, etc.): None
BUILDER: Ingalls I.W.Co. Marine Div., Decatur, Ala.
HULL NUMBER (Builder's): 1788
DATE COMPLETED: 1972
OWNER: Interstate Materials Transport Co., 600 West 10th Street, Wilmington, Delaware 19801
OPERATOR: Interstate Oil Transport Co., 216 Penn Center Plaza, Philadelphia, Pa. 19103

II. CIRCUMSTANCES SURROUNDING CASUALTY

NATURE OF CASUALTY (Check)

[X] STRUCTURAL FAILURE [ ] COLLISION [ ] FIRE/EXPLOSION

DATE OF CASUALTY: Unknown
TIME (Local): Unknown
SHIP'S LOCATION (Latitude and longitude; distance and true bearing from charted object, dock, anchorage, etc.): -

WEATHER (Check)

[ ] CLEAR [ ] PARTLY CLOUDY [ ] OVERCAST [ ] FOG [ ] RAIN [ ] SNOW [ ] OTHER (Specify)

HEIGHT OF SEA	DIRECTION OF SEA	HEIGHT OF SWELL	DIRECTION OF SWELL	SEA WATER TEMPERATURE	WIND DIRECTION	WIND FORCE IN KNOTS	AIR TEMPERATURE
-	-	-	-	-	-	-	-

SHIP'S SPEED (At time of casualty)	SHIP'S COURSE (True) (At time of casualty)	DRAFT FWD (Immediately before casualty)	DRAFT AFT (Immediately before casualty)
-	-	-	-

III. STRUCTURAL FAILURE

(Complete if a fracture or buckle has occurred in the shell, decks, or inner bottom within the amidship 2/3 length or in the stern frame. Sketches, plans or photos showing damages and extent of failure, apparent starting point or points, relative location of welds and other structural features and details of proposed or completed repairs should also be attached)

CLASS FRACTURE: II

DESCRIPTION OF FAILURE OR DAMAGE (Locate where failure started with respect to welds and other structural features, general history and any contributing factors, extent of damages to frames, hull plates and decks. Use additional sheets as necessary.)

Damage which occurred since last inspection (June 1974) consisted of fractures of frame members in the centerline area and outboard area of #1, #2, and #3 double bottoms. Damage is suspected to be caused due to either (1) sea conditions on route of operation, (2) construction to minimum ABS scantlings, or (3) lack of sufficient longitudinal strength members (only long. strength in cargo tank areas is center line bulkhead, side shell, long. tank bulkheads, and main deck). There are no double bottom longitudinals or cargo tank longitudinals as in typical tank barge construction. It was also found that deep web frames, which are spaced every fifth frame, were virtually unaffected.

PREVIOUS EDITION MAY BE USED

IV. COLLISION RESULTING IN STRUCTURAL DAMAGE

(Complete only when a collision results in the structure of the vessel being HOLED. A separate form should be completed on each vessel holed as a result of collision. The name and official number of each other vessel involved should be shown below. It is important to determine the location of damage, extent of flooding, and resulting heel, trim and draft. Use additional sheets if necessary, and photos of damage, if possible.)

GENERAL DESCRIPTION OF COLLISION AND RESULTING DAMAGE TO VESSEL "A", i.e. SUBJECT VESSEL OF THIS REPORT (Use sketch to indicate angle of collision and give brief description of damage. If vessel sank, give number of minutes to sink, behavior during sinking number of lives lost and number saved.)

N/A

VESSEL "A" EXTENT OF DAMAGE	LONGITUDINAL EXTENT OF HOLING (Measured in feet from bow or stern. Indicate which) FWD EDGE OF HOLE	AFT EDGE OF HOLE	TRANSVERSE EXTENT OF HOLING (Approx. feet in from side)	DESCRIPTION OF VERTICAL EXTENT OF DAMAGE (List decks or flats penetrated)
AT BULKHEAD OR WEATHER-DECK (Indicate)				

DEGREES HEEL AFTER FLOODING (Indicate port or starboard)	DRAFT FWD (After flooding)	DRAFT AFT (After flooding)

OTHER VESSELS OR OBJECTS INVOLVED		NAME (Vessel or object)	OFFICIAL NUMBER		NAME (Vessel or object)	OFFICIAL NUMBER
	B			E		
	C			F		
	D			G		

V. FIRE/EXPLOSION

SOURCE (Where and how started)	EXTENT OF DAMAGES (Areas damaged by smoke, fire and/or explosion)
N/A	

FIRE DETECTING AND EXTINGUISHING SYSTEMS INSTALLED IN DAMAGED AREAS (Describe equipment and effectiveness)

VI. DISPOSITION OF VESSEL

☐ TOTAL LOSS (Sunk or scrapped) ☐ LAID UP OR STORED WITHOUT REPAIRS ☐ TEMPORARY REPAIRS (Describe) ☑ PERMANENT REPAIRS (Describe) ☐ OTHER (Specify and describe)

See attached sheet

REPORT INCLUDES INFORMATION UP TO THIS DATE	NAME AND TITLE (Typed)	SIGNATURE
21 July 1976	M. H. EATON, CAPT, USCG Commanding Officer	M H Eaton

UNITED STATES SALVAGE ASSOCIATION RECORDS

° Damage reports are made for the American Hull Insurance Syndicate. These reports are proprietary and not available to the public (see below for possibility of release).

° USSA may be willing to release the detail reports providing ship names, owners, and other proprietary information are deleted. The exact procedure and funding for such an endeavor have not been established.

° The data collapsed from the damage reports to data cards is as follows:

a. A vessel is divided into 100 parts termed affected elements.

b. Vessels are divided into 17 types, with most of these types further subdivided into deadweight categories.

c. The world is divided into 880 geographical areas.

d. Casualty causes are comprised of 46 fortuitous events.

e. The repair costs for the repair of the three most costly affected elements are gathered, as well as the total cost of repairs.

f. The time to carry out repairs for each of the three most-costly-to-repair affected elements is recorded, as well as the total time for all repairs.

g. The status of repairs is recorded i.e., repairs carried out, deferred, partly carried out, etc.

° The data supplied to the USCC is the collapsed form, and was submitted on 80 column computer cards with the format shown on enclosure (USSA-1).

° MR&S surveyed the detailed reports in performance of the study of Reference 6 and found adequate details of structural failure and deformation for analysis were not recorded.

- Enclosure (USSA-1) indicates the format of the EDP data cards

- Further details of the code were not obtainable, but an inspection of some computer output indicated that, for instance, affected elements are grouped as "shell","side plating,"etc., i.e. in very general terms.

UNITED STATES SALVAGE ASSOCIATION, INC.
DAMAGE SURVEY ANALYSIS

VESSEL NAME ______________________________ CODING DATE __________

BEHALF CIRCUMSTANCE (YES = 1, NO = 0) [ ] 1

VESSEL NAME CODE [ ][ ][ ][ ] 2 3 4 5   FLEET CODE [ ][ ][ ] 6 7 8   TYPE CODE [ ][ ] 9 10

CASE NO. [ ][ ] 11 12 [ ][ ][ ][ ][ ] 13 14 15 16 17   CASUALTY DATE Mo. [ ][ ] 18 19 DAY [ ][ ] 20 21 YR. [ ] 22

CASUALTY LOCATION [ ][ ][ ] 23 24 25   SURVEY DATE Mo. [ ][ ] 26 27 DAY [ ][ ] 28 29 YR. [ ] 30

REPAIR AREA [ ][ ][ ] 31 32 33   AFLOAT = 0, DRYDOCKED = 1 [ ] 34   CONCURRENT REPAIRS? (YES = 1, NO = 0) [ ] 35

TOTAL ACTUAL REPAIR COST FOR SUBJECT CASE [ ][ ][ ][ ][ ][ ] 36 37 38 39 40 41 ($100's)

NOTE: NO CODING IN FIELDS BELOW THIS LINE BY CODING SECTION

NOTE: CROSS OUT FIELDS 42 TO 75 BELOW FOR BEHALF CIRCUMSTANCE

ALLEGED CAUSE [ ][ ] 42 43   EXCEPTION TO ALLEGED CAUSE (YES = 1, NO = 0) [ ] 44

AFFECTED ELEMENTS [ ][ ] 45 46   [ ][ ] 47 48   [ ][ ] 49 50

REPAIR STATUS [ ] 51   [ ] 52   [ ] 53   HAZARD (YES = 1, NO = 0) [ ] 54

REPAIR TIME FOR AFFECTED ELEMENTS [ ][ ] 55 56   [ ][ ] 57 58   [ ][ ] 59 60

REPAIR COSTS OF AFFECTED ELEMENTS [ ][ ][ ][ ][ ] 61 62 63 64 65   [ ][ ][ ][ ][ ] 66 67 68 69 70   [ ][ ][ ][ ][ ] 71 72 73 74 75 ($100's)

ANALYSIS DATE (DATE OF ENTRY) Mo. [ ][ ] 76 77 DAY [ ][ ] 78 79 YR. [ ] 80

REPAIR COSTS NOT CODED (IN $100's) = ____________________

THE SALVAGE ASSOCIATION OF LONDON

- The vessels are mainly those on the London Insurance Market. Reports are made of each casualty.

- Information Retrieval Cards are completed for every casualty. Enclosure (SAL-1) is a copy of the card for machinery and Enclosure (SAL-2) is a copy of the card for the hull. Note the data is similar to USCG and USSA.

- They are not concerned with structural analysis connected with damage, either on the cards or in their reports. A report was not available for review.

- The alleged cause and their opinion of the cause is stated.

- The data is not computerized.

- SAL was asked about the proprietary nature of their data but did not respond directly.

- The cost of repairs and lay-up days are recorded.

BEST AVAILABLE COPY

ENCLOSURE (SAL-1)

BOILERS

1. Babcock & Wilcox
2. Comb. Eng.
3. Foster & Wheeler
4. Hitachi
5. Kawasaki
6. Mitsubishi
7. Others
8. Scotch
9. Waste Heat
10. Yarrow

REPAIR AREA

G.R.T. '000's TONS

PRIME CAUSE

1. Alignment
2. Cavitation
3. Corrosion
4. Design
5. Erosion
6. Explosion
7. Fire
8. Grounding
9. Heavy Weather
10. Hydrogen Fire
11. L.O. Failure
12. Maintenance
13. Negligence
14. Water Shortage
15. Collision

MATERIALS FAILURES

1. Broken/Sheared
2. Cracked
3. Chemical Action: Corroded, Pitted, Wasted, Graphited
4. Mechanical Action: Grooved, Scored, Eroded, Cavitation, Scuffed
5. Burst, Ruptured, Collapsed
6. Burnt, Overheated, Wiped, Squeezed, Hammered, Porous
7. Leaking, Holed
8. Missing, Lost
9. Seized, Jammed
10. Choked, Sealed
11. Loose, Stuck

UNIT POWER H.P. '000's

Repairs - Completed

Repairs - Deferred

Repairs - Part Perm.

Repairs - Temp.

AGE AT CASUALTY

CASUALTY AREA

COST OF REPAIRS £'000's

D. | C. | P.P. | T.

Cost of Repairs: Estimated | Agreed

General Expenses

Special Factors

Alleged Cause

Surveyor's Opinion

Vessel | Type

Ex Names

Built | Year | G.R.T.

Instructions

Casualty

Salvor

Surveyor

Owner

Broker

TYPE OF VESSEL

1. Bulk carrier
2. Container/Lash
3. General Cargo
4. O.B.O.
5. Oil Rig
6. Others
7. Passenger
8. Reefer
9. Tanker
10. Tug
11. Yacht

AFFECTED PARTS - BOILERS

1. Automation Failure
2. Blowers
3. Brickwork
4. Casings
5. Drum
6. Firing Equipment
7. Fuel Contn.
8. Mountings
9. Oil comb.
10. Poor comb
11. O'heating
12. Priming
13. Safety Vs.
14. Tubes Boiler
15. Tubes stay
16. Tubes S.H.

AFFECTED PARTS - ENGINES

1. Bearings
2. Bedplates
3. Blowers
4. Bolts
5. Casings
6. Condensers
7. Controls
8. Coolant System
9. Crankcase
10. Crankshaft
11. Crosshead
12. Entablature
13. Gear Pinion
14. Gear Wheel
15. Gearing Casings
16. Governor
17. Guides
18. Liners
19. Oil system
20. Pistons
21. Propellor G.P. F.B.
22. "
23. Rotor
24. Stern Brgs
25. Stern Tube
26. Tailshaft
27. Valves
28. Others

SALVOR

1. Smitak
2. Wijsmuller
3. Murphy Pacific
4. Svitzer
5. Bugsier
6. Harms/Risdon/Beazley
7. F.C. Towing
8. Fukada
9. Nippon
10. Others

NO. DAYS REPAIRING

1. 5 Days
2. 10 "
3. 15 "
4. 20 "
5. 25 Days
6. 30 "
7. 40 "
8. 50 "
9. 80 "
10. 100 "

FLAGS

1. China
2. German
3. Greece
4. Holland/Belgium
5. India
6. Japan
7. Norway Scandinavia
8. Others
9. Panama
10. S. Africa
11. S. America
12. Taiwan
13. UK/Commit
14. U.S.A.
15. U.S.S.R.
16. Yugoslavia

BUILT

WHERE

1. U.S.A.
2. Japan
3. U.K.
4. Scandinavia
5. Benelux
6. Germany
7. France
8. Spain
9. Italy
10. Greece

YEAR

1. 1950-55
2. 1956-60
3. 1961-65
4. 1966-70
5. 1971-75
6. 1976-80
7. 1981-85
8. 1986-90
9. 1991-95
10. 1996-2,000

TYPE OF CONTROL

TURBINES

1. G.E.
2. Hitachi
3. Mitsubishi
4. Pametrada
5. Pratt & Whitney
6. Laval
7. Westinghouse
8. Kawasaki
9. Others
10.

AUXILIARIES

1. Cargo pumps
2. Cargo pump Turbines
3. Compressors
4. Control gear
5. Generator-Diesel
6. Generator-Turbines
7. Motors
8. Pipes
9. Pumps
10. Receivers
11. Steering Gear
12. Switch Boards
13. Winches
14. Windlass
15. Wiring

DIESEL ENGINES

1. Allen
2. Brons
3. B. & W.
4. Caterpillar
5. Crossley
6. Deutz
7. Doxford
8. Fiat
9. G.M.
10. Gotaverken
11. H. & W. (Hartland & Wolf)
12. Kelvin
13. Lister Blackstone
14. M.A.N.
15. Mirrlees
16. Mitsubishi
17. Newbury
18. Paxman
19. Perkins
20. Petter
21. Pielstic
22. Polar
23. Rolls Royce
24. Ruston
25. Stork
26. Sulzer
27. Volvo
28. Werk Spoor
29. Others

Diesel | Steam | Diesel | Steam

ENCLOSURE (SAL-2)

TYPE OF CASUALTY

W Abandoned; V Breaking; U Capsized; T Cargo Shifted; R Collision; Q Contact; P Contact with S.O.; O Consequential; N Corrosion; M Defective Workmanship; L Design; K Disabled; J Explosion/Fire; I Extinguishing or Refloating Damage; H Fuel or Water Shortage; G Grounding; F Heavy weather Acc.; E Heavy weather Int.; D Hurricane/Typhoon; C Latent Defects; B Leakage/Flooding; 1 Negligence - Crew; 2 Negligence - owners; 3 Others; 4 Overloading; 5 Owners Maintenance; 6 Pounding; 7 Racing; 8 Ranging; 9 Separating; 10 Stevedore Damage; 11 Stranding

SALVOR

1. Smit Tak
2. Wijsmuller
3. Murphy Pacific
4. Selco
5. Bugsier
6. Harms/Risdon/Beasley
7. E.C. Towing
8. Fukuda
9. Nippon
10. Others

TYPES OF CARGO

17 Refrigerated; 18 Others; 19 Liquid; 20 High Density; 21 General; Bulk

Q Acc.; P ...ships; O ...; N Bow.; M Electrical; L Equipment; K Fractures - Internal; J Fractures - Shell

AFFECTED PARTS

I Hatch Covers; H Hull Vibration; G Insulation; F Internals; E Machinery - Auxiliary; D Machinery - Deck; C Machinery - Propulsion Diesel; B Machinery - Propulsion Steam; A Pollution Caused; 1 Rudder; 2 Side Shell; 3 Stern; 4 Super Structure; 5 Wide combination; Others

AGE AT CASUALTY

NO. OF DAYS REPAIRING

1. 5 Days
2. 10 Days
3. 15 Days
4. 20 Days
5. 25 Days
6. 30 Days
7. 40 "
8. 50 "
9. 80 "
10. 100 "

YEAR OF CASUALTY

1. 1973
2. 1974
3. 1975
4. 1976
5. 1977
6. 1978
7. 1979
8. 1980
9. 1981
10. 1982

Vessel		Type	
Ex Names			
Built		Year	G.R.T.
Instructions			
Casualty			
Salvor			
Surveyor			
Owner			
Broker			

Alleged Cause	Surveyor's Opinion

Cost of Repairs		Special Factors
Estimated	Agreed	
T.		
P.P.		
C.		General Expenses
D.		

Machinery Amidships
Machinery Aft
Towage Required
Previous Similar Damage
Vessel in Ballast
Vessel Loaded
Vessel in Port
Vessel at Sea
Temporary Repairs
Part Permanent Effected
Completed Repairs
Deferred Repairs
W.P. Survey
Survey Incomplete
Not Surveyed
Comp. T.L.
Const. T.L.
T.L.
Salvage Rendered
Sunk

COST OF REPAIRS £000'S

Where Built

1. U.S.A.
2. Japan
3. U.K.
4. Scandanavia
5. Benilux
6. Germany
7. France
8. Spain
9. Italy
10. Greece

TYPE OF VESSEL

1. Bulkcarrier
2. Container/Lash
3. General Cargo
4. O.B.O.
5. Oil Rig
6. Others
7. Passenger
8. Reefer
9. Tanker
10. Tug
11. Yacht
12. LG Carrier
13. Chem. Tanker
14. Supply V.
15. Dredger

FLAGS

1. China
2. Germany
3. Greece
4. Holland/Belgium
5. Japan
6. Liberia
7. Norway/Scandanavia
8. Others
9. Panama
10. S. Africa
11. S. America
12. Taiwan
13. U.K./C'wealth
14. U.S.A.
15. U.S.S.R.
16. Yugoslavia

CASUALTY AREAS

REPAIR AREAS

YEAR OF BUILD

1. 1950-55
2. 1956-60
3. 1961-65
4. 1966-70
5. 1971-75
6. 1976-80
7. 1981-85
8. 1986-90
9. 1991-95
10. 1996-2,000

GROSS TONNAGE 0 - 0.5 - 1000000

LLOYD's LIST

- Mr. Pagan of Lloyd's Register of Shipping has indicated the casualty list in Lloyd's List is used by shipyards in identifying possible repair work.
- The descriptions of damage are very brief.
- Data is available to anyone.
- Data could be useful in a very general analysis of casualties.
- Enclosure LL-1 is a sample.
- All types of marine, non-marine, and aviation casualties are listed.
- The sources of data include: news services, classification societies, and insurance company representatives.
- Damage cost and lay-up time are not recorded.

Casualties

MARINE, NON-MARINE & AVIATION

MARINE

ACACIA (Japanese)
Hamburg, Dec 2 — *Acacia*: Attended at Bremen following opening up of No 1 bottom end bearing, No 2 crosshead bearing and No 4 main bearing and have noted extensive oxidisation of pins and journals together with scoring of surfaces. Bearings slightly wiped and crosshead upper half No 2 unit white metal fractured. Classification surveyor has requested remainder of journals to examine, which found in similar condition, and has recommended as temporary measure hand-polishing pins and journals. Crosshead pins to be machined this occasion as part permanent repair, for permanent repairs to crankshaft, same will require to be removed and ground in lathe and bearings remetalled. — Salvage Association's Surveyors. (See issues of Nov 17 and 26 and Dec 2.)

AGAPI (Greek)
See "Medara Line" under "Miscellaneous."

AJWA (Liberian)
See "Medara Line" under "Miscellaneous."

ALGORTA (hopper barge) (Spanish)
See *Oceanic Klif*.

ANABELLE (Cyprus)
See "Gale at Marseilles" under "Weather and Navigation."

ANTONIS (Liberian)
See "Gale at Bilbao" under "Weather and Navigation."

APOLLONIAN WAVE (Greek)
Paris, Dec 2 — *Apollonian Wave* is still adrift off western France.— United Press International. (See issue of Nov 30.)

APRICITY (British)
Holyhead, Dec 2 — Motor vessel *Apricity* repairs completed, sailed Dec 2 for Galway. (See issue of Nov 27.)

ARAXOS (Greek)
Maassluis, Dec 1 — Motor vessel *Araxos* arrived in the Nieuwe Waterweg Nov 30 from Las Palmas. (See issue of Nov 6.)

ARIS (Liberian)
Valletta, Dec 1 — *Aris* left Malta Nov 30 for Porto Empedocle. (See issue of Nov 30.)

ASTYANAX (Greek)
Lagos, Nov 30 — Motor vessel *Astyanax*: Surveyor visited vessel Nov 30 in Lagos Roads. Vessel alleges that after collision with motor vessel HERRO Oct 28 she started to take water in No 1 hold. Present situation vessel no bunkers and unable to use main pumps, which are steam-driven. No 1 hold making approximately 2 m per day pumping with portable pump. — Lloyd's Agents per Salvage Association. (Note — HERRO arrived Apapa / Lagos Sept 22 and sailed Nov 5 for Walvis Bay.)

ATHABASCA (British)
Spurn, Dec 1 — At 1840, GMT, motor fishing vessel *Athabasca*, GY 288, reported she had been hit by a red-painted vessel at Spurn Light-vessel. Vessel had come up astern and slid down the port side. After inspection, *Athabasca* reported no visible damage. At 1850, GMT, Norwegian motor vessel HAUGNES contacted Spurn pilots reporting collision. Contacted by rescue headquarters, Humber, for details and reported fishing vessel was on starboard side, showing red light, and suddenly crossed and brushed down side. Both vessels proceeding on passage, *Athabasca* to fishing grounds and HAUGNES (from Grimsby) to Bergen. — Coastguard.

ATLANTIS (Greek)
Las Palmas, Dec 1 — *Atlantis*, on laden voyage Las Palmas for Lagos: All crew rescued by *Gordyy* and landed Las Palmas. — Lloyd's Agents per Salvage Association. (See issue of Dec 1.)

Las Palmas, Dec 2 — *Atlantis*: Master today informs vessel grounded approximately one kilometer offshore and when abandoned was lying over to starboard with water up to 1 m from deck with water on port side up to approximately 6 m from deck. Engine-room flooded within 30 minutes of vessel grounding. — Lloyd's Agents per Salvage Association.

BAHIA DE GUAYANILLA 2
See "Overdue Vessel."

BANGKOK (Thai)
Manila, Dec 1 — *Bangkok* in

CHITOSE MARU NO. 2
See "Japanese Fishing Vessels Arrested by Russia" under "Miscellaneous."

CITTA DI SAVONA (Italian)
See "Vessels in Collision at Singapore."

CLAUS LUHRS (West German)
Antwerp, Dec 1 — *Claus Luhrs* sailed Nov 30 for Bohus. (See issues of Nov 27 and 30.)

EIKO MARU NO. 3
See "Japanese Fishing Vessels Arrested by Russia" under "Miscellaneous."

ENERGIE (West German)
Hamburg, Dec 2 — Owner of West German motor lighter *Energie* reports lighter sank about 0730, Dec 1, during stormy weather on the lower Elbe near Brokdorf. *Energie* was en route from Hamburg to Brokdorf with a cargo of stones and water entered the hatch. Master and one man jumped into the water and swam ashore. Understood lighter and cargo will be raised shortly.

ENERGY VITALITY (Liberian)
Bremen, Dec 2 — Steam tanker *Energy Vitality* grounded at 0730 today. It is intended to lighter the vessel and then to instruct tugs to assist in refloating. (Note — *Energy Vitality*, Forcados for Wilhelmshaven, is reported to have grounded in the vicinity of Wilhelmshaven.)

Wilhelmshaven, Dec 2 — Rescue workers today fought to keep *Energy Vitality*, aground in Jade Bay, from breaking apart. The vessel struck bottom north of Wilhelmshaven in storms and began to list. Coast Guards said 30 tons of oil had leaked from the vessel and formed a slick six miles long. — United Press International.

EVANTHIA (Liberian)
Rotterdam, Nov 22 — Motor tanker *Evanthia* surveyed in dry dock at Rotterdam in respect of touching bottom Mar 14. Repairs in hand at Rotterdam. — Salvage Association's Surveyors.

FRANCESCA (Panamanian)
See "Gale at Marseilles" under "Weather and Navigation."

GORCE (Polish)
See *Kutno II*.

HAUGNES (Norwegian)
See *Athabasca*.

KARL KRUSHTEYN (R
Calais, Nov 29 — Mot
Krushteyn sailed Nov 2
(See issue of Nov 25.)

KEF HAWK (Cyprus)
See "Labour Dispute
national Transport Wor
"Miscellaneous."

KING PELEUS (Greek)
See "Gale at Bil
"Weather and Navigation

KING WILLIAM (Briti
Moji, Nov 26 — Motor
King William left Kure
Port Hedland. (See issue

KINGS STAR (Norwegi
Cleveland, Dec 1 — M
Kings Star, disabled,
Cleveland.
Cleveland, Dec 1 — A
encrusted with ice, was
Cleveland this afternoon
powerless on Lake Erie
Her master had radioed
Guard in Detroit yesterda
vessel had lost her e
generators but was not in a
danger. Helicopters, aircra
Guard cutters were dispa
dian Coast Guard buoy te
reached the vessel about
north of Cleveland abo
None of the 17 persons o
reported injured. Gale w
up and SW winds of 30-4
causing seas of 8-10 ft, a
spokesman in Cleveland
Star was adrift for abo
before the tow was esta
was bound Nova Scotia w
soya beans. — United P
national.

KINRIKI MARU NO. 7
London, Dec 2 — M
Kinriki Maru No. 7, 49
capsized at Hachijo Jima O

KUTNO II (Polish)
Szczecin, Dec 2 — Acc
local Press, motor tanker GO
motor ore carrier *Kutno II*
Szczecin-Swinoujscie fairw
Kutno II, alleged seriousl
discharges her export carg
start of repairs.

LAKE PALOURDE (Liber
New York, Nov 22 — Ste
Lake Palourde, carryin
barrels of Indonesian crud
aground just inside Angels G
Angeles harbour at 0605. N
harbour entrance was closed
The vessel refloated at 205
day after lightening 50,00
oil. There was no spillage a
sustained no apparent d
American Institute of
Underwriters.

LJUTA (Maltese)
See "Medara Line
"Miscellaneous."

LOTTE DANIA (Danis

AMERICAN BUREAU OF SHIPPING

- ABS has detailed survey reports. They have been collected since 1965 and number 9,000 for approximately 9,000 ships.
- ABS surveyors act on behalf of United States Salvage at times.
- The detailed reports do not give enough detailed information for a structural engineer to evaluate the problem.
- The data has been collapsed to computer format.
- Many times the cause of failure is blamed on "heavy weather" in the reports. This may be for convenience at times.
- Not all surveyors have a detailed background in structural analysis.
- Damage cost and lay-up time are not recorded.

LLOYD'S REGISTER OF SHIPPING RECORDS

- Data collected on ships registered and surveyed by Lloyd's (40,000 hull and machinery reports per annum).
- Detailed damage reports are not available to public.
- General data collected is put on a computer data base and is available to public.
- Cost of repair and lay-up time is not recorded.

TANKER ADVISORY CENTER RECORDS

- Acquire information on casualties from Lloyd's List
- Concerned with full time and part time petroleum product carriers only.
- Started in January 1964 and now have 19000 casualty files.
- Casualty reports are kept on each ship (see enclosure TAC-1 for an example). In addition, casualties are filed under the codings noted on enclosure TAC-2. The system is not computerized.
- A principal use of the files has been to trace the history of particular ships that are under consideration for purchase or lease.
- Enclosure TAC-3 is an example of the studies performed by TAC.

Enclosure: (TAC-1)

REPORTED CASUALTIES TO TANKER OWNED BY

PETRI CIA. DI NAV. S.A.
c/o Jalan Kali Besar Barat 43, Djakarta

MT OCEAN TANKER, 20,328 DWT; Panamanian Flag; built 1958. Formerly Fina Allemagne, Purfina Allemagne. Sold to Petri at Carthagena,Spain April 1975

Casualties

August 30, 1965 Touched Bottom	Touched bottom at Dordrecht, Old Maas, Netherlands while coming from Botlek, Rotterdam. Damage,if any, unknown.
December 1, 1965 Stranded	On voyage from Aden and Gothenburg to Uddevalla, with cargo of gasoil, grounded south of Uddevalla. Vessel refloated without assistance and proceeded to Uddevalla, where she was discharged and inspected. Vessel proceeded to European Continental port for docking and repairs. No details of damages provided.
November 25, 1967 Heavy Weather Damages	Surveyor at Singapore reported fractures in aftpeak bulkhead and cargo tanks #7,8,&9 Center,engine-room telegraph unserviceable due salt-water contamination,heavy knock in No. 2 cylinder due to 2 smashed rings. All foregoing damages due to heavy weather. Vessel sailed 4 days after damages reported.
January 26, 1968 Windlass Damage	On weighing anchor for sailing about 7:30 a.m. at Teneriffe, from London for Persian Gulf, port windlass cylinder block cracked. Repairs completed and vessel sailed Feb. 9.
September 16,1970 Hit While At Anchor	Hit while anchored a.m. in Flushing Roads, Scheldt River by vessel outward bound. Ocean Tanker inbound from Aden. Damage in way amidships to bulwarks and stanchions on several decks. Motor lifeboat crushed and smashed and davits buckled. Repairs deferred.
February 27, 1974 Engine Damage	Arrived Singapore Roads, in ballast, where agent requested survey of cooling pump main engine motor damage. Left for Persian Gulf March 7.
April 6, 1974 Generator Failure	Enroute Mena al Ahmadi for Isle of Grain, arrived Cape Town where agent reported diesel generator failure. Sailed April 16.
September 3, 1974 Engine Room Fire	While lying in Martigues-Lavera,France fire broke out in engine room and was extinguished after 20 minutes. One crew member taken to hospital with serious burns. Sailed Sept.4, for Huelva, Spain. No damages, if any, reported.

NOTE: The foregoing casualties were all obtained from Lloyd's List, the daily newspaper published by Lloyds of London. The casualties have been retained by the Tanker Advisory Center starting January 1, 1964. The Tanker Advisory Center does not guarant the accuracy of the information contained herein, nor does it accept responsibility for errors or omissions or their consequences.

Prepared October 4, 1976

Enclosure:(TAC-2)

CODE FOR TANKER CASUALTIES

Description of Casualty

11 weather damage at sea

12 weather damage in port underway

13 weather damage in port moored

21 stranding in coastal waters

22 stranding in port

23 stranding in river

24 stranding in unreported area

31 collision at sea

32 collision in coastal waters

33 collision in port

34 collision in river

35 collision in unreported area

41 contact damage

42 hit bottom, grounded

43 hit dock,buoy or structure

44 hit vessel moored to dock

45 hit vessel at anchor

46 struck submerged object

47 hit by vessel while anchored

48 hit by vessel while moored

49 hit by assisting tug boat

51 fire &/or explosion,cargo tanks

52 fire &/or explosion, pumproom

53 fire &/or explosion,engine room

54 fire &/or explosion,main engine

55 fire &/or explosion, boilers

56 fire &/or explosion,other area

61 damage to mach., prop,rudder,etc.

71 lost anchor &/or chain

72 alleged crew negligence

73 ice damage

74 flooded engine room

75 blacked out

76 lube oil system contaminated

77 engine trouble

78 pumproom flooded

80 steering gear trouble

81 oil spill

82 damage from war or hostilites

83 other casualty

84 broke down at sea

85 stopped at sea for repair

90 scrapped

91 sold for scrap

92 converted

Note: There is no 79 under description. It is an extra.

Revised August 6, 1976

Effect of Casualty

A diverted for repairs
B returned to port for repairs
C remained in port for repairs

E towed into port
F towed part way then under own power
G tow requested but underway before tug arrived
H tug accompanied vessel to port

J speed reduced because of damage

K lightered cargo

L #### tons of damaged steel
M ## person (s) dead or missing
N ## person (s) severely injured

O lost ###### tons of oil to the environment
P lost an unknown quantity of oil to environment

Q total loss
R constructive total loss
S compromised total loss

T vessel abandoned by crew

V dock, buoy or structure reported damaged
W dock, buoy or structure heavily damaged

Y other vessel heavily damaged
Z other vessel reported damaged

Under Effect of Casualty there is no X. This letter is used in coding to indicate no effects listed.

Enclosure: (TAC-3)

TANKER ADVISORY CENTER

315 WEST 70TH STREET, NEW YORK, N. Y. 10023

(212) 873-3844

ARTHUR McKENZIE, DIRECTOR

REPORT

STUDY OF TYPE, NUMBER AND FREQUENCY
RATIOS OF CASUALTIES ON ORE/OIL, BULK/OIL,
AND OTHER TANKERS DURING 1973 AND 1974.

MARCH 1975

TO

CAPTAIN JOHN BICKNELL, MARINE MANAGER
AUSTRALIAN NATIONAL LINE
SOUTH MELBOURNE, AUSTRALIA

STUDY OF TYPE, NUMBER AND FREQUENCY
RATIOS OF CASUALTIES ON ORE/OIL, BULK/OIL,
AND OTHER TANKERS DURING 1973 AND 1974.

MARCH 1975

INTRODUCTION

This report presents the results of a study of the type, number and frequency ratios of casualties on ore/oil, bulk/oil and other tankers during the two year period of 1973 and 1974. The study was performed for Captain John Bicknell, Marine Manager, of Australian National Line, South Melbourne as authorized by teletype dated March 3,1975.

DATA SOURCE

The casualty data used in this study has all been obtained from Lloyd's List, the daily marine newspaper published since 1734 by Lloyd's of London. The statistics of the number, tonnage, size and age groupings of the vessels used in the report have been obtained from the publication The Tanker Register compiled by H. Clarkson & Company Ltd. of London. The calculation of casualty frequency ratios has been developed from these two sources by the Tanker Advisory Center. The frequency ratios expressed as % were derived by dividing the number of casualties experienced for a type of vessel by the number of such vessels at risk as of the mid-point of the two year period, namely January 1, 1974. In some instances the corresponding frequency ratios were developed for the deadweight tonnage involved in casualties divided by the deadweight tonnage at risk. Unless indicated otherwise the frequency ratios referred to are based on the number of vessels involved.

GENERAL BACKGROUND

Ore/oil and bulk/oil vessels are becoming more numerous in recent years. As of January 1975 there were an estimated 216 o/o vessels with a deadweight capacity of about 23,000,000 tons. And the b/o vessels with a capacity of nearly 18,000,000 DWTs numbered 174. Attachment A shows the cross sections of a tanker, bulk carrier, ore/oil and bulk/oil vessel. Ore/oil vessels have been growing larger in recent years with the Svealand of 278,000 DWT now in service. The bulk/oil vessels are also getting larger but the biggest one afloat as of 1/1/74 was the Tsuruga Maru of 140,000 DWTs. According to H. P. Drewry (Shipping Consultants) Ltd. London percentage of time spent trading in oil by these combination carriers has been decreasing from 91% during 1972, to 77% in 1973 and 51% during 1974. Tankers other than combination carriers, of over 6,000 DWT number about 3800 as of 1/1/75 with an estimated total capacity of nearly 240,000,000 DWTs.

CASUALTY EXPERIENCE-GENERAL

The casualties included in this study have been classified into seven groups as follows: weather damage; strandings; collisions; contact damage; fires & explosions; damage to machinery, shafts, propellers, etc.; and other casualties. Attachment B lists the breakdown of subdivisions used within each category and illustrates kind of casualties included under contact damage, damage to machinery, shafts, propellors,etc, and other casualtie Each category of casualty shall be considered separately with comments and conclusions as appropriate. The casualty experience is contained in Tables 1,2 & 3 with additional data on casualties indicated on Attachments B & C.

TABLE 1.

OIL CARRIERS
CASUALTY FREQUENCY RATIOS
1973 - 1974

		ORE/OIL		BULK/OIL		TANKERS		ALL OIL CARRIERS	
		Casu-alties	Ratio %	Casu-alties	Ratio %	Casu-alties	Ratio %	Casu-alties	Ratio %
WEATHER DAMAGE	#	14	6.9	2	1.3	232	6.5	248	6.3
	MDWT	1,028	4.9	203	1.3	12,835	5.9	14,066	5.5
STRANDINGS	#	18	8.9	6	3.8	211	5.9	235	6.0
	MDWT	1,483	7.1	499	3.1	10,356	4.8	12,338	4.9
COLLISIONS	#	10	4.9	6	3.8	132	3.7	148	3.8
	MDWT	673	3.2	534	3.4	6,527	3.0	7,734	3.0
CONTACT DAMAGE	#	22	10.8	12	7.6	445	12.5	479	12.2
	MDWT	1,345	6.4	1,266	8.0	20,280	9.4	22,891	9.0
FIRES & EXPLOSIONS	#	9	4.4	13	8.3	145	4.1	167	4.2
	MDWT	860	4.1	1,693	10.6	9,522	4.4	12,075	4.8
DAMAGE TO MACH., SHAFTS, PROPS., ETC.	#	19	9.4	34	21.7	713	20.0	766	19.5
	MDWT	2,090	10.0	3,367	21.2	43,785	20.2	49,242	19.4
OTHER CASUALTIES	#	23	11.3	21	13.4	354	9.9	398	10.1
	MDWT	1,606	7.7	2,523	15.8	23,249	10.7	27,378	10.8
TOTALS	#	115	56.7	94	59.9	2,232	62.6	2,441	62.1
	MDWT	9,085	43.3	10,085	63.4	126,554	58.3	145,724	57.5
FLEET AT RISK as of 1/1/1974	#	203		157		3,568		3,928	
	MDWT	20,963		15,911		216,720		253,594	

APPENDIX B

SAMPLES OF DATA ANALYSIS METHODS

UNITED STATES SALVAGE ASSOCIATION DATA ANALYSIS METHOD

- USSA has developed a computer program that analyzes their punch card data.
- The program capabilities are limited and as described on Enclosure (USSA-1).
- The program and output are not available to the public in any form (consequently no sample is included).
- USSA has not made use of the program yet, but have had requests from the American Hull Insurance Syndicate.
- The program appears to be useful for macroscopic research project evaluation.

Enclosure (USSA-1)

UNITED STATES SALVAGE ASSOCIATION, INC.

EXECUTIVE OFFICE 99 JOHN STREET NEW YORK, N.Y. 10038 CABLE ADDRESS: UNISALVAGE, N.Y.

TELEPHONE (212) 233-7400

December 13, 1972

To: Data Processing Department
Attention: Mr. D. R. Best

From: H. S. Townsend

Subject: Damage Survey Analysis (DSA)
Coding Run

We are desirous of ascertaining the extent of, and nominal descriptions of, damages which have been collected under DSA from its inception to date, of certain of the various types of vessels involved in the system, and for all vessels grouped as a whole.

Please arrange to provide us with the following:

VESSEL TYPE CODES

10 - 14	General cargo vessels (Non-World War II, excluding container/cargo vessels)
22 - 26	Tank vessels 0 to 110,000 tons DWT
27 - 31	Tank vessels 110,000 to 210,000 tons DWT
32 - 34	Tank vessels over 210,000 tons DWT
35 - 39	Solid bulk carriers (stone, grain, coal, etc.)
40 - 44	Ore/Oil vessels 0 to infinity tons DWT
45 - 49	Solid bulk carriers, self-unloaders (stone, grain, coal, etc.)
50 - 54	Bulk chemical carriers

55 - 59	Liquid gas carriers
60 - 64	Container/cargo vessels
65 - 69	Container vessels
73 - 76	Refrigerated cargo vessels
77	Passenger vessels
78	Railroad car ferries
79	Automobile, roll-on-roll-off vessels
80	Barge carriers (Lash, Seabee, etc.)
81	Oceanographic survey and research vessels

The type codes are to be lumped together, for example, there is no necessity of individually collecting information on type code 11, 12, and 13 for the first entry, the total type classification 10 to 14 being the desired group; in the second entry it will be noted that three separate groups are requested.

For each of the 17 (total) type groups, excluding behalf circumstance cases (block 1), and ignoring repair status (blocks 51, 52 and 53), please provide:

1. Sum of number of vessels
2. Sum of number of casualties (Cases).
3. Sum of total repair cost (blocks 36-41).
4. A run with alleged cause (blocks 42 and 43) as lead control, showing:
   A. Sum of total repair cost in each alleged cause category in descending order of total repair cost.
   B. Sum of cases for each entry in (A) above.
   C. Average total repair cost for each entry in (A) above, i.e., (A) ÷ (B) for each entry.

5. A run with affected elements (blocks 45-46, 47-48, and 49-50), as lead control showing:

   A. Sum of affected elements repair cost (blocks 61-65, 66-70, and 71-75) in each affected element category, in descending order of affected elements repair cost.

   B. Sum of cases for each entry in (A) above.

   C. Average affected elements repair cost for each entry in (A) above, i.e., (A) ÷ (B) for each entry,

6. A run with alleged cause as lead control, showing:

   A. Sum of affected elements repair cost in each affected element category in descending order of affected elements repair cost, in each alleged cause category.

   B. Sum of cases for each entry in (A) above.

   C. Average affected elements repair cost for each entry in (A) above, i.e., (A) ÷ (B) for each entry.

7. A run with alleged cause as lead control, showing:

   A. Sum of affected elements repair time (blocks 55-56, 57-58, and 59-60) in each affected element category in descending order of repair time, in each alleged cause category.

   B. Sum of cases for each entry in (A) above.

   C. Average affected elements repair time for each entry in (A) above, i.e., (A) ÷ (B) for each entry.

8. Sum of repair time for all affected elements.

   A. Sum of affected elements repair time.

   B. Sum of affected elements.

   C. Average affected elements repair time, i.e., (A) ÷ (B).

9. Please repeat 1 through and including 8 above without separating vessels into type groups, again excluding behalf circumstance cases, and ignoring repair status.

Please ensure that all cards to be cancelled account deferred/completed repair status are so cancelled (we have no such cancellations on hand here for the month of December).

To aid in interpreting what we desire, the following is what we want to achieve:

Items 1, 2 and 3

The average total repair cost per vessel and per casualty, by type of vessel.

Item 4

Specific and average total repair cost per casualty, by cause, by type of vessel.

Item 5

Specific affected elements and specific and average repair costs of same, per casualty, by type of vessel.

Item 6

Specific affected elements and specific and average repair costs of same, per casualty, by cause, by type of vessel.

Item 7

Specific and average time for repairs for specific affected elements, per casualty, by cause, by type of vessel.

AD-A042 650   ROSENBLATT (M) AND SON INC SAN FRANCISCO CALIF   F/G 13/10

SHIP STRUCTURAL CASUALTY DATA ASSESSMENT.(U)

JUL 77 J C DAIDOLA, N M MANIAR, R STANLEY   N00024-76-C-4255

UNCLASSIFIED   NL

2 OF 2

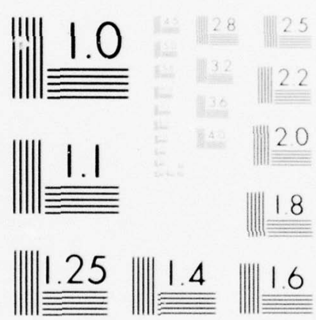
AD A042650

END

DATE FILMED

8-77

DDC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Item 8

The average affected elements repair time, per casualty, by type of vessel.

Item 9

All as per 1 through 8, for all vessels considered as a group.

Please advise should you have any questions.

H. S. Townsend

Enclosure:
DSA Form No. 100

cc with enclosure:
Mr. R. T. Luehman - Treasurer
Mr. W. J. Weir - Coding Section
Mrs. A. Winters- " "

UNITED STATES COAST GUARD

- A program has been in existence since 1963.
- The input data for the program is obtained from forms CG-2692, CG-924E and related reports;and coded in accordance with instructions in Marine Casualty Statistics, Form CGHQ-4095 (11-61).
- Enclosure (USCG-1) is a copy of the coding instructions.
- Very few purely structural aspects are considered.
- Estimated damage cost is considered.
- A sample run of the program was not received; however the program output is supposed to be publicly available.
- The program appears to be useful for macroscopic research project evaluations.

CODING INSTRUCTIONS
for
COMMERCIAL VESSEL CASUALTIES
(As Amended FY 1976)

The following coding instructions are applicable to vessel casualties such as collisions, groundings, and fires, whether or not there is loss of life or injuries as a result of the vessel casualty. The input data shall be obtained from forms CG-2692, CG-924E and related reports; coded in accordance with these instructions and those found on Code Sheet - Marine Casualty Statistics, Form CGHQ-4095(11-61).

SECTION 2 OF CGHQ-4095 - DATA REQUIRED IN ALL CASES

CARD COLUMN 1-5: Case Serial Number; assigned consecutively for ten years. Where two or more vessels are involved, such as in a collision, the same case serial number is given to all involved vessel cards. The same is true for the personal accident cards if there are injuries, death, or missing persons involved in the vessel casualty.

Commencing July 1, 1962 the first case number will be 30001 and continue upwards. The three (3) indicates Fiscal 1963. All numbers above 30000, but no higher than 34999, will indicate vessel casualties.

If a personnel injury or death occurs that does not involve a vessel casualty, see coding instructions "Commercial Vessel - Personnel Injuries and Deaths." Thes case serial numbers will be in the 35000 series commencing 1 July 1962.

CARD COLUMN 6-11: Official Number

Documented Vessels of U.S.	-- Use Official Number
State Numbered Vessels	-- Use State Number
Named/Unnumbered Vessels	-- Use Name
Naval Vessels	-- Use Type of Designation
Foreign Vessels	-- Use Country of registry

CARD COLUMN 12: Coast Guard Inspected

1. yes
2. no
3. unknown (Valid FY 63-70)

GENERIC TYPE

CARD COLUMN 13-14: Type of Vessel:

01 - Artificial Island or fixed structure, including mobile drill rigs (46 CFR 140.10-5)
02 - Cargo Vessel (freight) Inspected U.S. vessels only
03 - Cargo barges (freight) (see also 28)
04 - Commercial vessels that carry freight and off-shore supply vessels
05 - Construction and wrecking vessels, including vessels such as drill tenders, pile drivers, derrick barges, drill ships and barges
06 - Dredges, self-propelled
07 - Dredges, non-self propelled
08 - Fishing vessels (excluding sport fishing, charter fishing vessels)
09 - Tugs and towboats- also Unmanned Bow Thruster Unit
10 - Passenger vessels (other than ferries) over 65 feet and 100 or more G.T.
11 - Passenger vessels (other than ferries) over 65 feet and less than 100 G.T.
12 - Passenger vessels (other than ferries) not more than 65 feet
13 - Ferries over 65 feet and 100 or more G.T., carrying passengers or passengers and vehicles.
14 - Ferries over 65 feet and less than 100 G.T., carrying passengers, or passengers and vehicles.
15 - Ferries not more than 65 feet, carrying passengers or passengers and vehicles
16 - Passenger barges (including ferry barges)
17 - Tankships
18 - Tank barges (inflammable and combustible cargoes) (see also 29)
19 - Public vessels (passenger)
20 - Public vessels (cargo); excluding GAA vessels
21 - Public vessels (tanker); including USNS tankers
22 - Public vessels (other)

Public vessels of the United States, or municipality used for public purposes and exempt from the provisions of Title 52. Includes such vessels as Navy, Air Force, Army, Coast Guard, Coast and Geodetic Survey, Corps of Engineers, MSTS, and USNS.

23 - All other U.S. vessels and crafts such as pleasure, research, cableships, seismographic or those not otherwise classified above.
24 - Foreign flag vessels (passenger)
25 - Foreign flag vessels (freight)
26 - Foreign flag vessels (tanker)
27 - Foreign flag vessels (other)

28 - Cargo barges (dangerous and hazardous cargoes)
29 - Tank barges (dangerous and hazardous cargoes); including barges inspected under subchapter I and O
30 - Hover Craft
Note: See card column 49-50 to describe specific type vessel (Beginning FY 69)

CARD COLUMN 15: Propulsion;
1 - Steam
2 - Motor (diesel)
3 - Gasoline
4 - Sail
5 - Non-self propelled
6 - Other, including gas turbine
7 - Nuclear
(-)-Unknown

CARD COLUMN 16: Person in Charge of Vessel Maneuvers;
1 - Licensed Master
2 - Licensed Pilot (Federal) serving under authority of Federal License
3 - Licensed Pilot (State) serving under authority of State License (when serving on foreign vessel & some U.S. vessels)
4 - Licensed Mate
5 - Licensed Operator (Towboats, small passenger)
6 - Documented or Certificated Personnel
7 - Commissioned Officer (Navy, C.G., etc.)
8 - Unlicensed or Undocumented,

9 - Foreign Pilot or Master, or other Foreign Personnel
0 - Unmanned
(-)- Unknown
Beginning FY 72 - Equipment Failure When Fault on Part of Engineroom Personnel
A - Licensed Chief Engineer
B - Licensed Engineer
C - Documented Engineer, excluding entry rating
D - Documented Persons other; entry ratings other documented persons
E - Unlicensed/undocumented engineer
F - Foreign Engineer
G - Unmanned Engineroom*
H - Other

*This code takes precedence over cases where person enters unmanned engineroom while attempting to correct casualty in progress.

CARD COLUMN 17-22: Date of Casualty; FY 63-FY 73;
Show month in first two columns, thus January as 01 or November as 11.
Day in second two columns, thus 5th as 05 or 22 nd as 22.

CARD COLUMN 80: Special Indicator; Beginning FY 69;
0 - No significant data
1 - Light oil pollution
2 - Moderate oil pollution
3 - Heavy oil pollution
4 - Uninspected mobile oil drill
5 - Gas chemist or gas free certificate
6 - Photographs (eff. 5/17/68)
7 - Radiotelephone mentioned in the report
8 - Bridges involved(if collision w/bridge or lock & dam - indicate bridge)
9 - Locks or dams involved
- - Hurricane
* - Sealanes
Year in last column, thus 1961 as 1.

Example: 10 July 1969 would be 071009.

BEGINNING FY 74
CARD COLUMN 17,18: Same as previous year

CARD COLUMN 19,20: Marine Inspection Office investigating casualty

AA	Albany	BF	New York	CM
AB	Anchorage	BG	Oswego	CN
AC	Baltimore	BH	Paducah	
AD	Boston	BJ	Port Arthur	
AE	Buffalo	BK	Philadelphia	
AF	Charleston	BL	Pittsburgh	
AG	Chicago	BM	Portland, Maine	
AH	Cincinnati	BN	Portland Oreg.	
AJ	Cleveland	BP	Providence	
AK	Corpus Christi	BQ	Portsmouth	
AL	Detroit	BR	Savannah	
AM	Dubuque	BT	San Diego	
AN	Deluth	BU	Seattle	
AP	Galveston	BV	San Francisco	
AQ	Guam	BW	Saint Ignace	
AR	Honolulu	BX	San Juan	
AT	Houston	BY	St. Louis	
AU	Huntington	BZ	Tampa	
AV	Jacksonville	CC	Toledo	
AW	Juneau	CD	Wilmington, N. C.	
AX	Los Angeles	CE	London	
AY	Louisville	CF	Bremen	
AZ	Memphis	CG	Singapore	
BB	Miami	CH	Saigan	
BC	Mobile	CJ	Manila	
BD	Nashville	CK	Yokohoma	
BE	New Orleans	CL	Rotterdam	

CARD COLUMN 21: Month Investigation Completed (Special Indicator Code appears in CARD COLUMN 80 Beginning FY 74)

1 JAN
2 FEB
3 MAR
4 APR
5 MAY
6 JUN
7 JUL
8 AUG
9 SEPT
Ø OCT
A NOV
B DEC

CARD COLUMN 22: Year Casualty Occurred.

CARD COLUMN 23: Time Of Day;

1 - Day
2 - Night
3 - Twilight
(-)- Unknown

CARD COLUMN 24: Type of Investigative Report;

1 - Marine Board
2 - Narrative
3 - Letter of Transmittal

SECTION 2 OF CGHQ-4095 - VESSEL CASUALTY DATA

CARD COLUMN 25: Card No; FY 70

For primary vessel code - 1
For secondary vessel code - B
For all other vessel codes - C through Z

CARD COLUMN 26: Gross Tonnage;

1 - Not over 15
2 - Over 15 to 100
3 - Over 100 to 300
4 - Over 300 to 500
5 - Over 500 to 1,000
6 - Over 1,000 to 5,000
7 - Over 5,000 to 10,000
8 - Over 10,000 to 15,000
9 - Over 15,000
(-)- Unknown

CARD COLUMN 27: Length in Feet;

1 - 65 feet or under
2 - Over 65 to less than 100
3 - 100 to less than 200
4 - 200 to less than 300
5 - 300 to less than 400
6 - 400 to less than 500
7 - 500 to less than 600
8 - 600 to less than 700
9 - 700 and over
(-)- Unknown

CARD COLUMN 28: Hull Materials;

1 - Steel
2 - Wood
3 - Cement
4 - Plastic
5 - Aluminum
6 - Other, including ferro-cement
(-)- Unknown

CARD COLUMN 29: Age of Vessel; If Rebuilt (FY 70 only)

1 - Less than 5 years	A
2 - 5 to less than 10	B
3 - 10 to less than 15	C
4 - 15 to less than 20	D
5 - 20 to less than 30	
6 - 30 to less than 40	
7 - 40 to less than 50	
8 - 50 and over	
(-)- Unknown	

CARD COLUMN 30-31: Body of Water Where Casualty Occurred;

01 - Inland, Atlantic - all waters covered by Inland Rules of the Road on the Atlantic Coast of the U.S., its territories and possessions.

02 - Inland Gulf - all waters covered by Inland Rules of the Road on the gulf of the U.S. (Also see page 23.)

03 - Inland, Pacific - all waters covered by Inland Rules of the Road on the Pacific Coast of the U.S.

04 - Western Rivers - all waters covered by the Western Rivers Rules. (BEGINNING FY 76 THIS CODE WAS DELETED. See pages 22 & 23 for revised Western River Codes.)

05 - Great Lakes - all waters covered by the Great Lakes Rules. (See page 29.)

06 - Ocean, Atlantic and all seas bordering thereon.

07 - Ocean, Pacific and all seas bordering thereon including the China Seas.

08 - Ocean, Indian and all seas bordering thereon including the Arabian and Red Seas.

09 - Ocean, Mediterranean

10 - Ocean, Arctic

11 - Ocean, Caribbean

12 - Ocean, Gulf

13 - Foreign waters

(Beginning FY 69) See CARD COLUMNS 45-47 to amplify location.

CARD COLUMN 32-33: Nature of Casualty;

01 - Collision with vessel, meeting situation
02 - Collision with vessel, crossing situation
03 - Collision with vessel, overtaking situation
04 - Collision with vessel anchored or moored (use only if not docking/undocking
05 - Collision with vessel while docking or undocking
06 - Collision with vessel in fog (Takes precedence over 01, 02, 03)
07 - Collision with vessel, NOC (including minor bumps tug and vessel)

CARD COLUMN 32-33: Nature of Casualty; (CONT.)

08 - Collision with Floating or Submerged objects (other than ground)
09 - Collision with Fixed Objects, piers, *bridges, *Locks & Da-
*Use indicater CARD COLUMN 80
10 - Collision with ice or ice fields
11 - Collision with aids to navigation, fixed or floating
12 - Collision, other than with vessel, NOC (Offshore Rigs - Seaplanes)

13 - Explosion and/or fire involving liquid bulk cargo (includes vapors)
14 - Explosion and/or fire involving general cargo
15 - Explosion and/or fire involving vessel's fuel (includes vapors)
16 - Fires, vessel structure
17 - Fire, vessel equipment (only when damage to vessel structure is incidental, minor or absent) including crank case explosions, beginning FY 71
18 - Explosion, boiler (whether or not fire results)
19 - Explosion, pressure vessels and compressed gas cylinders
20 - Explosion and/or fire - not otherwise classified

21 - Groundings with damage
22 - Groundings, no damage (cannot have monitary damage to vessel listed)

23 - Founderings
24 - Capsizing with or without sinking
25 - Flooding, swamping, without sinking

26 - Heavy weather damage and weather generally (Beginning FY 69 rarely used heavy, weather not nature)
27 - Cargo Damage, no damage to vessel
28 - Material failure, vessel structure
29 - Material failure, machinery and associated engineering equipment
30 - Material failure, equipment (other) including cargo gear, propeller shaft
31 - Casualty not otherwise classified, undetermined or insufficient information- earthquake
Beginning FY 69-- Enemy action, vessel disabled due to fouled propeller.
32 - Barge breakaway

Beginning FY 70
CAUSE/FACTOR

CARD COLUMN 34:

A. P.F. State Pilot
B. P.F. Federal Pilot
C. P.F. Foreign Pilot, Foreign Master
D. P.F. Licensed Personnel
E. P.F. Certificated Personnel
F. P.F. Unlic., Uncer. Personnel
G. P.F. Unlicensed Pleasure Boat
H. P.F. All Others (Longshoremen & Harbor workers)
I. Calculated Risk

CARD COLUMN 35:

A. RULES OF THE ROAD (FY 1972) Use Special Rules of Road Codes in C/C 36-38 and 39-41
B. STRUCTURAL FAILURE - Improper loading
C. LOOKOUT - Improper/failure to post
D. STRUCTURAL FAILURE - excessive speed in heavy weather
E.
F.
G. MISJUDGED EFFECTS - wind, current, speed
H. NAVIGATION - reliance on floating aids to navigation
I.
J. NAVIGATION - Failed to ascertain position
K. NAVIGATION - Failed to utilize all available navigation equipment
L. VESSEL SHEERED/agreement reached
M. FAILURE TO PROPERLY ALIGN TOW
N. LACK OF LOCAL KNOWLEDGE
O.
P. INEXPERIENCED PERSONNEL
Q. MANEUVERED W/O PROPER ASSISTANCE
R. CARELESSNESS/INATTENTION (asleep)
S. IMPROPER CORRECTIVE PROCEDURES
T. POOR SEAMANSHIP - fouled wheel/shaft
U. FAILED - improperly determined height of tide; failed to correct
V. INADEQUATE CONTROL OF ASST. VESSEL
W. IMPROPER MOORING/TOWING (tripping)
X. IMPROPER SAFETY PRECAUTIONS - loading inflammable liquid/fueling/repairs
Y. IMPROPER SECURING/RIGGING
Z. OTHER, not otherwise classified

Beginning FY 70
CAUSE/FACTOR

CARD COLUMN 34:	CARD COLUMN 35:
J. Storms, Heavy Weather	A. TYPHOON, HURRICANE, etc.
K. Adverse Weather	B. GALE FORCE WINDS
	C. ADVERSE WEATHER - restricted vis. only
	D. SMALL CARFT WARNINGS
	E. WINDS, SMALL CRAFT - gale force
	F. LARGE SWELL - as across bar
	G. CARGO SHIFT
	H. ANCHOR FAILED TO HOLD/DRIFTED
	J. OTHER________________
	K. UNEXP. GUSTY WIND, docking/undocking
	L. TOW/MOORING PART DUE HEAVY WEATHER
	M. SQUALLS - reduced visibility/wind
	N. ANCHOR PARTED
	P. LT. VESSEL SET DOWN ON PIER/LOCK
	Q. STRUCTURAL FAILURE
	R. LT. VESSEL SET DOWN ON MOORED VESSEL
	S.
	T. ICE
	U.
L. Unusual Currents	A. ERRATIC
	B. STRONG CURRENTS/NARROW CHANNEL
	C. AGREEMENT REACHED/CROSS CURRENT, set tow
	D. STRONG SURGE
	E. OUTDRAFT/BACKLASH from dam/lock
	F.
	G.
	H.
	Z. OTHER

Beginning FY 70
CAUSE/FACTOR

CARD COLUMN 34:

M.	Sheer, Suction, Bank Cushion	A.	NARROW CHANNEL
		B.	NAVIGATING CLOSE TO SHORE
		C.	
		D.	
		E.	
		Z.	OTHER
N.	Depth less than charted	A.	CHARTS ERRONEOUS
		B.	AREA SHOALLED/SILTED
		C.	POSITION OF HAZARD DOUBTFUL
		D.	PUBLICATIONS ERRONEOUS
		E.	
		F.	
		G.	
		H.	OTHER
O.	Restricted maneuvering room - no personnel fault	A.	Not otherwise classified
P.	Structural Failure - no personnel fault	A.	WASTED PLATE AND INTERNALS/or wood rotted
		B.	WASTED WELDS
		C.	FRACTURE - PLATES AND INTERNALS
		D.	FRACTURE - WELDS
		E.	INDENT - Minor
		F.	SET UP - Major
		G.	BUCKLING
		H.	DESIGN
		J.	EXPLOSION and/or FIRE - structural failure as the result of
		K.	
		L.	
		Z.	OTHER

Beginning FY 70
CAUSE/FACTOR

CARD COLUMN 34:

Q. Equipment Failure/normal wear
R. Equipment Failure/material fault
S. Equipment Failure/design
T. Equipment Failure/P.F. of operating personnel (including improper operation, lack of maintenance.)

CARD COLUMN 35:

A. MAIN STEAM SYSTEM
B. AUXILIARY STEAM SYSTEM
C. FEED AND CONDENSATE SYSTEM
D. SALT WATER SYSTEM
E. FRESH WATER SYSTEM (excluding feed system)
F. CARGO OIL SYSTEM
G. FUEL OIL SERVICE SYSTEM
H. FUEL OIL TRANSFER SYSTEM
I.
J. LUBE OIL SYSTEM
K. HYDRAULIC SYSTEMS
L. PNEUMATIC SYSTEM
M. REFRIGERATION SYSTEM
N. VENTILATION SYSTEM
P. SANITARY SYSTEM & HULL DRAINAGE SYSTEM (Incl. Bilge System)
Q. FIRE FIGHTING EQUIPMENT & LIFE SAVING EQUIPMENT
R. DRILLING EQUIPMENT
S. ELECTRICAL (All equip)
T. LPG/LFG/O2 SYSTEM (All compressed gases, except decompression chamber)
U. DECOMPRESSION CHAMBER, FY 71
V. CRANKCASE EXPLOSION, FY 71
W. DECK EQUIPMENT - cargo (winches, booms, etc.)
X. DECK EQUIPMENT - other (anchor windlass, chain, mooring line)
Y. FAILURE OF MACHINERY SUPPORTS
Z. OTHER

BEGINNING FY 70
CAUSE/FACTOR

CARD COLUMN 34:	CARD COLUMN 35:
U. UNSEAWORTHY	A. FAILURE OF WOOD HULL PLATING/MODERATE SEAS
X. IMPROPER MAINTENANCE	B. STEEL HULL DETERIORATED
	C. FAILURE TO BLOW TUBES
	D. NOT SUITABLE FOR ROUTE
	E.
	F.
	Z. OTHER
V. UNKNOWN/OTHER	A. BARGE BREAKAWAY, IMPROPER MOORING
	B. BREAKAWAY DUE TO WAKE WASH
	C. ENEMY ACTION
	D. CHEMICAL SPILL
	E. VANDALISM
	F. BLOW-OUT
	G. ENGINE ROOM FIRE, UNDETERMINED ORIGIN
	H. FIRE, OTHER/UNDETERMINED
	J. DOCK BOLLARD FAILURE
	K. UNKNOWN
	L. DRILLING EQUIPMENT
	M. STABILITY
	N. PROGRESSIVE FLOODING
	P. VESSEL OVERRUN AND SUNK
	Q. WAKE DAMAGE FROM OTHER VESSEL
	R. FIRE BARGE LOADED
	S. FIRE BARGE EMPTY-NOT GAS FREE
	Z. OTHER

Beginning FY 70
CAUSE/FACTOR

CARD COLUMN 34:	CARD COLUMN 35:
W. Fault other vessel/personnel	A. NOT APPLICABLE B. VESSEL INTENTIONALLY GROUNDED TO AVOID COLLISION C. BRIDGE TENDER CLOSED DRAWBRIDGE D. BRIDGE TENDER FAILED TO FULLY OPEN SPAN E. OVERTAKING VESSEL TOO CLOSE, SHEERED F. GROUNDED TOW TO PREVENT BARGE FROM SINKING H. GROUNDED TOW TO PREVENT TUG FROM SINKING J. K. Z. OTHER
Y. Floating Debris, submerged object (other than bottom)	A. SUBMERGED OBJECT B. WOODEN HULL HOLED C. DAMAGED BOW THRUSTER D. DAMAGED ____________ E. F. G. Z. OTHER
Z. Insufficient Horsepower/ Inadequate Tug Assistance	A. NO TUGS AVAILABLE B. NOT ENOUGH TUGS ORDERED C. UNABLE TO CONTROL LIGHT TOW/WIND D. UNABLE TO CONTROL TOW/CURRENT E. UNABLE TO CONTROL TOW IN BEND F. G. H. Z. OTHER

Beginning FY 71

RULES OF ROAD VIOLATIONS

Enter in Card Column 36-38:

A. RULE 2 IMPROPER LIGHTS
B. RULE 3 LIGHTS FOR TOWING
C. RULE 4 NOT UNDER COMMAND LIGHTS/SPECIAL OPS. (OR PILOT RULES-SPECIAL ORS.)
RULE 5-10 LIGHTS TOWED VESSEL/SMALL VESSEL/PILOT VESSEL/FISHING VESSEL - STERN LIGHT
D. RULE 11 ANCHOR LIGHTS
E. RULE 15 FOG SIGNALS
F. RULE 16 SPEED IN FOG/SIGNAL FORWARD OF BEAM. EARLY

Substantial Action

G. RULE 17 SAIL VESSELS
H. RULE 18i MEETING SITUATIONS
I. RULE 18iii DANGER SIGNAL
J. RULE 18v BEND SIGNAL
K. RULE 18viii OVERTAKING
L. RULE 19 CROSSING SITUATION
M. RULE 20 SAIL VESSEL RIGHT OF WAY/EXCEPT IN NARROW CHANNEL
N. RULE 21 PRIVILEGED VESSEL MAINTAIN C&S
P. RULE 22 BURDENED VESSEL AVOID CROSSING AHEAD
Q. RULE 23 BURDENED VESSEL KEEP CLEAR
R. RULE 24 OVERTAKING VESSEL KEEP CLEAR
S. RULE 25 KEEP TO STBD SIDE OF CHANNEL
T. RULE 26 RIGHT OF WAY OF FISHING VESSELS
U. RULE 27 GENERAL PRUDENTIAL RULE
V. RULE 28 COURSE SIGNALS INTERNATIONAL/BACKING INLAND
W. RULE 29 RULE OF GOOD SEAMANSHIP (LOOKOUT)
Z. RULE __ FAILURE TO RENDER ASSISTANCE

IF LESS THAN 3 VIOLATIONS ENTER---

Beginning FY 71

RULES OF ROAD VIOLATIONS

Enter in Card Column 39-41:

COMMENTS (UP TO 3 COMMENTS)

A. EXCESS SPEED
B. INSUFFICIENT POWER
C. WRONG SIDE OF CHANNEL
D. FAILURE TO SOUND SIGNALS
E. MEETING SITUATION, TURNED LEFT
F. CROSSING SITUATION, BURDENED FAILED TO GIVE WAY
G. FAILED TO STOP OR BACK
H. EVASIVE MANEUVER TOO LITTLE, TOO LATE
I. OVERTAKING VESSEL FAILED TO KEEP CLEAR
J. OVERTAKEN VESSEL FAILED TO MAINTAIN COURSE & SPEED
K. WIND, SEA OR CURRENT FACTORS
L. AGREEMENT REACHED, VESSEL SHEERED
M. IMPROPER/NO LOOKOUT
N. RADIO TELEPHONE
P. RS 4450 ACTION INTENDED
R. IMPROPER LIGHTS/SHAPES (Beginning FY 71)
T. PERSON IN CHARGE INTOXICATED

IF LESS THAN 3 VIOLATIONS ENTER---

Beginning FY 72

CARD COLUMN 36-38: Area of Causal Connection
CARD COLUMN 39-41: Additional Contributing Factors

900 - RS 4450 Action intended
990 - Coast Guard Assistance (Beginning FY 70)
999 - No additional areas of contributing factors
991 - Violation of Law

Descriptive Codes

026 - Lookout
027 - Congested areas, docks, piers - restricted maneuvering
028 - Buoys, aids to navigation
029 - Excessive speed
030 - Channels - restricted maneuvering
039 - Weather, generally
040 - Currents and tides
031 - Poor visibility

Miscellaneous

048 - Failure to secure (or improper)
059 - Replenishment at sea
068 - Disabled, require tow
069 - Background lighting obscured aids to navigation
070 - Yard repairs includes gas free (Beginning FY 73)
071 - Overloading
072 - Improper loading or stowage
073 - Insufficient ventilation
076 - Cargo
078 - Sunken wreck
079 - Tug assisting

Machinery, Miscellaneous

116 - Failure of equipment due to improper or lack of maintenance

Galley and Stewards Department

140 - Person in charge/responsible persons intoxicated

CARD COLUMN 36-38: Area of Casual Connection (Contributing Factors)

CARD COLUMN 39-41: Additional Contributing Factors

900 - RS 4450 Action intended
990 - Coast Guard Assistance (Beginning FY 70)
999 - No additional areas of contributing factors

Hull and Associated Parts

011 - Plates and framing (steel hull vessels)
012 - Planks, frames, fastenings (wood hull vessel)
013 - Bulkheads and decks
014 - Tanks (including cargo, fuel, water, lube oil, double bottom tanks, etc.)
015 - Holds and hatches, hatch beams, hatch covers
016 - Superstructure
017 - Ladders, gangways, stairs, accommodation ladders
018 - Rails and guards
019 - Masts, booms, cargo gear (including winches)
020 - Struts, stern tube, rudder, shoe
021 - Ventilators
022 - Watertight closures and assorted equipment
023 - Hull part, not otherwise classified
024 - Quarters, living spaces, toilets, etc.
025 - Fishing gear

Navigation

026 - Lookout
027 - Congested areas, docks, piers - restricted maneuvering
028 - Buoys, aids to navigation
029 - Excessive speed
030 - Channels - restricted maneuvering
031 - Poor visibility
032 - Steering gear including steering engine, rudder, auto pilot
033 - Radar
034 - Fathometer, sounding machine, lead line
035 - Engine order telegraph, bell pulls, pilot house engine controls
036 - Navigation lights (improper use)
037 - Whistle, bell, horn, signals (improper use)
038 - Navigation equipment - not otherwise classified
039 - Weather, generally
040 - Currents and tides

CARD COLUMN 42: WEATHER - TIME OF CASUALTY;

1 - Clear
2 - Partly Cloudy
3 - Overcast
4 - Fog
5 - Rain
6 - Snow
7 - Other
(-)- Unknown or insufficient information

CARD COLUMN 43: VISIBILITY AT TIME OF CASUALTY;

1 - Less than 1/4 mile
2 - 1/4 to less than 1/2 mile
3 - 1/2 to less than 1 mile
4 - 1 mile to less than 2 miles
5 - 2 miles and over
(-)- Unknown or insufficient information

CARD COLUMN 44: WIND AT TIME OF CASUALTY;

1 - Calm
2 - 1-3 knots
3 - 4-10 knots
4 - 11-16
5 - 17-27 knots
6 - 28-40 knots
7 - 41-55 knots
8 - 56-65 knots
9 - above 65 knots
(-) - Unknown or insufficient information

CARD COLUMN 45-47: AIR TEMPERATURE AT TIME OF CASUALTY;

Beginning FY 69

SPECIFIC LOCATION OF CASUALTY (See pages 21 thru 29.)

CARD COLUMN 48: SEA CONDITIONS AT TIME OF CASUALTY;

1 - Calm
2 - Sea/swell,5,15 feet or slight chop
3 - Sea/swell,16-20 feet or moderate chop-rough
4 - Sea/swell,21-40 feet or heavy chop/very rough
5 - Sea/swell,over 40 feet
6 - Ice
(-)- Unknown or insufficient information

CARD COLUMN 49-50: SEA TEMPERATURE AT TIME OF CASUALTY;

Beginning FY 69

SPECIFIC TYPE VESSEL - SEE CODES

CARD COLUMN 51-52: CREW MEMBER KILLED OR MISSING & PRESUMED DEAD

CARD COLUMN 53-54: PASSENGERS KILLED OR MISSING & PRESUMED DEAD

CARD COLUMN 55-56: LONGSHOREMEN & HARBOR WKRS KILLED OR MISSING & PRESUMED DEAD

CARD COLUMN 57-58: OTHER KILLED OR MISSING & PRESUMED DEAD

CARD COLUMN 59-60: CREW MEMBERS INJURED & INCAPACITATED OVER 72 HRS

CARD COLUMN 61-62: PASSENGERS INJURED & INCAPACITATED OVER 72 HRS

CARD COLUMN 63-64: LONGSHOREMEN & HARBOR WKRS INJURED & INCAPACITATED OVER 72 HRS

CARD COLUMN 65-66: OTHERS INJURED & INCAPACITATED OVER 72 HRS

INDICATE NUMBER AS 01,02, etc. FOR CARD COLUMNS 51-66

CARD COLUMN 67-7-: Estimated Loss/Damage to Vessel

CARD COLUMN 71-74: Estimated Loss/Damage to Cargo

CARGO COLUMN 75-78: Estimated Loss/Damage to Other Property

Code in units of thousands but first round off to nearest thousands. For example: If the value is $1,500 round it off to $2,000 and code as 0002. If the value is $4,499 round it off to $4,000 and code as 0004, for card columns 67-78.

CARD COLUMN 79: Vessel a Total Loss

1 - Yes 2 - No

Section 3 of Form CG-4095 - To be completed <u>only</u> if a vessel casualty involves deaths or injuries. See coding instructions - Personnel Injuries and Deaths. Also add card column 49-50 Nature of Casualty to Section 3 which will take the same code equivalent placed in Section 2 - Vessel Casualty Data, card column 32-33, Nature of Casualty.

If deaths or injuries are not incurred as the result of a vessel casualty - leave blank.

UNITED STATES COAST GUARD - BATTELLE MEMORIAL INSTITUTE

- Not completed yet. Necessary characteristics have been outlined, and RFP for development of details and software will shortly be distributed.

- Program will consider U.S. flag vessels only. The complete history of each ship will be available, including casualties, servicings, and required servicings.

- The report forms the USCG is currently using will be revised to adapt to this program. The narrative on present forms will be omitted and items will be listed for choosing.

- The program will include thousands of elements for each ship; machinery as well as the hull.

- It is not clear whether or not the structural area of the program will contain the details necessary for microscopic studies.

AMERICAN BUREAU OF SHIPPING

- The ABSIRS data analysis system is available for use for a fee through ABS computers. This system is a version of the IBM General Information System (GIS).

- The data base is the Hull Technical Note File and is taken from the ABS detailed survey reports. Short abstracts of these reports are kept in computer memory and can be output.

- Enclosure (ABS-1) indicates the type of data that is available.

- A user (ABS Principle Engineer) of the program felt that it required a significant amount of user interface and funds.

- Cost data is not considered.

- Program appears to be useful for macroscopic research project evaluation.

HULL TECHNICAL NOTE FILE

	Field No.	Page No.
CODES segment		
Damage Code	1	1
Direction/Location	2	2
Part Modifier	3	2,3,4,5
Parts	4	5,6
MASTER segment		
First Ten Characters of Vessel Name	5	1
Technical Note Key	6	1
TEXT segment		
Comments	7	6
Line Number	8	6

MASTER segment

Field: 5	First ten characters of Vessel name	
	Sort:	N
	Justification:	L-alphanumeric
	Format:	Length=10; as input

Field: 6	Technical Note Key	
	Sort:	Y
	Justification:	L-alphanumeric
	Format:	Length=19; as input
	Field Redefined:	
	TABSID, length=7	Vessel ID Key
	TDATE, length=4	Date Vessel added to file
	TNUMB, length=7	Vessel report number
	TDEPT, length-1	Hull or Machinery identifier

CODE segment

Field: 1	Damage Codes	
	Sort:	$Y_{(1)}$
	Justification:	L-alphanumeric
	Format:	Length=3; as input
	Codes:	BUC = Buckled, bent, distorted, collapsed, set-in, set-up
		CAT = Catastrophe
		CRA = Cracked, parted, torn, burst, fractured, ruptured, broken
		ERO = Eroded, corroded, wasted, pitted, grooved, porous, scored
		VIB = Vibration
		WEL = Welding

Field: 2	Direction/Location			
	Sort:	Y(2)		
	Justification:	L-alphanumeric		
	Format:	Length=3; as input		
	Codes:	BØW	=	Bow framing
		CG	=	Cargo gear
		CLN	=	Collision
		DU	=	Drilling units
		EQ	=	Equipment
		ER	=	Engine room
		FIR	=	Fire, explosion, blowout
		GDN	=	Grounding, stranding
		HA	=	Hatches
		HD	=	Holds
		IND	=	Independent tank vessels (including LNG and LPG carriers)
		LNG	=	Liquified natural gas carrier
		LPG	=	Liquified petroleum gas carrier
		PAN	=	Panting region (forward hold or cargo oil tank)
		RUD	=	Rudder
		STF	=	Stern frame except rudder
		STR	=	Stern structure except rudder and stern frame
		SUP	=	Superatructure

Field: 3	Part Modifiers			
	Sort:	Y(3)		
	Justification:	L-alphanumeric		
	Format:	Length=3; as input		
	Codes:	ANC	=	Anchor
		ASH	=	Anchor shackle
		BAL	=	Balanced
		BAR	=	Barge shape mat
		BB	=	Bulbous bon
		BOS	=	Boss
		BR	=	Bridge
		BTE	=	Bitter end
		BTM	=	Bottom shell

CB	=	Collision Bulkhead
CBT	=	Center Ballast tank
CCL	=	Chain links
CCT	=	Center cargo tank
CHI	=	Cylindrical horizontal insulated
CHP	=	Cylindrical horizontal pressurized
CHR	=	Cylindrical horizontal refrigerated
CHS	=	Cylindrical horizontal semi-refrigerated
CIR	=	Circular/oval shape (MAT)
CL	=	Chain locker
CLK	=	connecting links
COA	=	Coaming
COF	=	Coffer dams
COI	=	Conical insulated
COM	=	Complete superstructure
CON	=	Conventional gear
COP	=	Conical pressurized
COR	=	Conical refrigerated
COS	=	Conical semi-refrigerated
COU	=	Couplings
CSL	=	Crane and stiff legs
CTG	=	Contraguide
CVI	=	Cylindrical vertical pressurized
CVR	=	Cylindrical vertical refrigerated
CVS	=	Cylindrical vertical semi-refrigerated
DCI	=	Double-cylinder insulated
DCP	=	Double-cylinder pressurized
DCR	=	Double-cylinder refrigerated
DCS	=	Double-cylinder semi-refrigerated
DIA	=	Diagonals
DT	=	Deep tank
EL	=	Elevators
ER	=	Engine room
FLR	=	Floors
FLT	=	Flat or deck
FOC	=	Forecastle
FP	=	Forepeak
FWD	=	Forward

GUD	=	Gudgeon
GUN	=	Radius gunwale
HD	=	Hold down
INS	=	Insulation
MRG	=	Motion restraint guides
MST	=	Masts or posts
PIL	=	Pillars
PIN	=	Pintle
PLT	=	Plating
RUN	=	Running gear
SAD	=	Saddle
SFN	=	Support foundation
SFR	=	Side framing
SID	=	Side shell
SNB	=	Secondary barrier
SS	=	Shear strake
STA	=	Standing gear
STR	=	Stringer
TSH	=	Tank shell
TST	=	tank stiffeners
TSU	=	Tank support
TT	=	Tank top
WEB	=	Web frame

TEXT segment

Field: 7	Comments	
	Sort:	N
	Justification:	L-alphanumeric
	Format:	Length=70; as input
Field: 8	Line Number	
	Sort:	Y
	Justification:	R-numeric
	Format:	Length=2; as input

HOL	=	Holds, store space
HOR	=	Horizontal
HSE	=	House
HVL	=	Heavy lift gear
INT	=	Intersection columns or legs
IP	=	Inner post
KOR	=	Kort nozzle (fixed or movable)
LEG	=	Legs (jack-up units)
LOT	=	Long'l O.T. bulkhead
LSW	=	Long'l swash bulkhead
LW	=	Lower wing tank
LWT	=	Long'l W.T. bulkhead
OP	=	Outer post
PLA	=	Platform
PMI	=	Prismatic (membrane) insulated
PMP	=	Prismatic (membrane) pressurized
PMR	=	Prismatic (membrane) refrigerated
PMS	=	Prismatic (membrane) semi-refrigerated
POD	=	Pods
POP	=	Poop
PR	=	Pump room
PSI	=	Prismatic (self-supporting) insulated
PSP	=	Prismatic (self-supporting) pressurized
PSR	=	Prismatic (self-supporting) refrigerated
PSS	=	Prismatic (self-supporting) semi-refrigerated
RH	=	Rudder horn, horn type
RK	=	Rake
RQD	=	Raised quarter deck
SC	=	Steel covers
SHO	=	Shoe, shoe type
SID	=	Side shell
SPD	=	Spade
SPI	=	Spherical insulated
SPL	=	Single plate

SPP	=	Spherical pressurized
SPR	=	Spherical refrigerated
SPS	=	Spherical semi-refrigerated
STO	=	Stock
SU	=	Self-unloading
TOT	=	Trans. OT bulkhead
TSW	=	Trans. swash bulkhead
TUB	=	Tube
TWT	=	Trans. W.T. bulkhead
UW	=	Upper wing tank
VER	=	Vertical column
VOD	=	Void
WBT	=	Wing ballast tank
WC	=	Wood cover
WCT	=	Wing cargo tank

Field: 4 Parts

Sort: Y(4)

Justification: L-alphanumeric

Format: Length=3; as input

Codes:

BFR	=	Bottom framing
BHD	=	Bulkhead
BIL	=	Bilge plating
BOM	=	Boom
BTM	=	Bottom shell
BUR	=	Burtoning gear
CAS	=	Casting
CC	=	Collision chock
CST	=	Crane structure
CVK	=	Center vertical keel
DFR	=	Deck framing
DK	=	Deck, flat or platform
DP	=	Drip pan
FDN	=	Foundation
FIT	=	Fittings
FLR	=	Floors
FØI	=	Hydrofoil
FOR	=	Forging
FRM	=	Framing
FRT	=	Front bulkheads

LLOYD'S REGISTER OF SHIPPING DATA ANALYSIS METHOD

- The Lloyd's data handling system was developed to allow identification of design and damage problems.
- Identities of ships and owners are not output.
- Cost of damage repair is not available.
- The data system can be used by the public at a nominal charge for time used in retrieving data. This charge is typically $50-$100 per run.
- From description the program seems to be similar to that of ABS (in fact it is a version of the IBM-CIS).
- The data base appears to be larger than that of ABS.

APPENDIX C

LIST OF ORGANIZATIONS/INDIVIDUALS CONTACTED

1. UNITED STATES NAVY

- Mr. Steven Arntson
  Code 6128
  Naval Ship Engineering Center
  Washington, D.C.

- Mr. Al Novak
  Code 912221
  Fleet Materials Office
  Mechanicsburg, Penna.

2. UNITED STATES COAST GUARD

- CDR William Ecker
  G-MA
  Washington, D.C.

- LT. James Comerford
  G-MA
  Washington, D.C.

- CDR Parent
  G-MVI
  Washington, D.C.

- LT. Robert Sancrant
  G-MVI
  Washington, D.C.

- LCDR Arthur Whiting
  G-MMI
  Washington, D.C.

- Mr. William . Cleary
  G-MMT-5
  Washington, D.C.

- CDR Steve Davis
  R&D
  Washington, D.C.

- LCDR Edward Chazal
  G-MMT-4
  Washington, D.C.

- LCDR Gordon Piche
  G-MMT-4
  Washington, D.C.

3. U.S. SALVAGE ASSOCIATION, INC.

- Mr. Robert G. Walsh, Jr.
  Asst to President
  99 John St.
  New York, N.Y. 10038

- Mr. R. Jaeschke
  Vice President
  99 John Street
  New York, N.Y. 10038

4. Mr. H.S. Townsend, P.E.
   (Former V.P., U.S. Salvage)
   30 Maniton Road
   Westport, Connecticut 06880

5. THE SALVAGE ASSOCIATION OF LONDON

- Mr. C. A. Sinclair
  Chief Surveyor - London
  London, England

6. THE AMERICAN BUREAU OF SHIPPING

- Mr. Don Liu
  Principal Engineer
  R&D
  45 Broad St.
  New York, N.Y.

- Mr. Richard Barry
  ABSCOMP
  20 Broad St.
  New York, N.Y.

7. LLOYD'S REGISTER OF SHIPPING

- Mr. A. Pagan
  Surveyor
  17 Battery Place
  New York, N.Y.

8. TANKER ADVISORY CENTER

- Mr. Arthur McKenzie
  Director
  315 West 70th St.
  New York, N.Y.

9. MARINE MANAGEMENT SYSTEMS, INC.

- Mr. John N. Hayes
  Senior Marine Analyst
  300 Broad St.
  Stamford, Connecticut

UNCLASSIFIED
Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) M. Rosenblatt & Son, Inc. 350 Broadway, New York, N.Y. 10013	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

(6) SHIP STRUCTURAL CASUALTY DATA ASSESSMENT.

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

(9) Technical Report.

5. AUTHOR(S) (First name, middle initial, last name)

(10) John C./Daidola,
Naresh M./Maniar
Robert/Stanley

6. REPORT DATE (11) Jul 1977	7a. TOTAL NO. OF PAGES 127 (12) 136.	7b. NO. OF REFS
8a. CONTRACT OR GRANT NO. Contract No. 4255 b. PROJECT NO. SR-247 c. d.	9a. ORIGINATOR'S REPORT NUMBER(S) Task No. 6120-690 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) (15) N00024-76-C-4255	

10. DISTRIBUTION STATEMENT

Distribution of this document is unlimited

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY Naval Ship Engineering Center

13. ABSTRACT

406864

DD FORM 1 NOV 65 1473 (PAGE 1)

S/N 0101-807-6801

UNLIMITED
Security Classification